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INTRODUCTION OF THE TUNGSTEN LAMP.

The topic which excited interest above all others at the recent Chicago Electric Light convention was that of the tungsten lamp. Two papers were presented on the subject, one by Mr. W. W. Freeman, dealing with it in a general way, and another by Mr. P. D. Wagoner, treating specifically of the application of the tungsten lamp to series incandescent lighting. Greater systematic effort appears to have been made in applying the new lamp to this latter service and to others where the gas flame lamp has been heretofore difficult to meet in competition, than to purposes of general illumination. Recently we have referred to several instances in which central stations have, by means of the tungsten lamp installed on its ordinary lighting mains, easily displaced so-called gas "arcs," and the figures and facts presented by Mr. Wagoner seem to bear out his statement that the tungsten lamp will place series incandescent electric lighting entirely beyond competition from its present naphtha, gasoline and gas mantle rivals. The data which he gives as to the life of the lamp bear out the most sanguine claims made on this score. In one installation of 172 lamps, an average life of 1350 hours was obtained, while in a test conducted on 18 lamps, 12 gave a life of over 2000 hours without perceptible decrease in efficiency. Mr. Wagoner did not hesitate to state that an average life of 1350 hours at 1.25-watts per candle can reasonably be expected from the tungsten lamp, even in its present stage of development. The extraordinary efficiency of the lamp with respect to current consumption has obscured its superiority over the carbon filament lamp with respect to quality of light, length of life and maintained candle-power. Indeed, if the tungsten lamp had an energy efficiency only equal, or even somewhat inferior, to that of the carbon filament lamp, these points of superiority would undoubtedly cause it to displace the carbon lamp almost as rapidly as its aggregate advantages will cause the present occupant of the field soon to become a thing of the past. Moreover, comparisons of tungsten and carbon filament lamps with respect to energy consumption should not be made upon the basis of the rated efficiency of the latter; that is to say, while the average efficiency of the tungsten lamp will not vary far from 1.25 watts per candle, the so-called 3.1-watt carbon-filament lamp may easily have an average efficiency reaching 4.5 watts or even more. Several months ago we noticed a report of measurements of the lamps used on a certain central-station circuit, in which it is recorded that of 363 carbon-filament lamps tested, all but eight showed a consumption which varied from 4.8 to 5.5 watts per candle-power, and that in some instances the consumption approached 15 watts per actual candle-power.

The paper by Mr. Freeman gives a résumé of answers from 501 central stations located in 49 states, territories and countries in which the National Electric Light Association has membership, which were given to comprehensive questions submitted in order to bring out the experience and views of the managers

of the plants addressed concerning high-efficiency lamps. These replies indicate that many companies have by means of the tungsten lamp already made notable progress in obtaining business heretofore difficult or impossible to secure. The replies to questions asking for an opinion as to the probable effect of the tungsten and other high-efficiency lamps upon the electric lighting industry, disclosed a remarkable consensus of opinion in favor of the new illuminant; while a few are solicitous as to the effect of the use of the tungsten lamp on the station income, a large majority agree that the tungsten lamp will prove of decided benefit to the industry for the reasons that it will for the first time permit of real competition, so far as price is concerned, with gas and gasoline, and that present customers will utilize the lamp to secure more light for the same money rather than be content with the same light for less money. Throughout, the tone of the replies is jubilant that the industry has at last been relieved of the danger of competition from flame illuminants, which competition has yearly become more serious and threatened in time to displace entirely the incandescent lamp in some classes of service where formerly it was thought to have a permanent status. The discordant note which occasionally appears in the replies does not, as a rule, seem to be justified. Those who appear to consider inevitable great reductions of income are probably not of the class who are now mapping out policies whereby reductions of receipts will be averted by the education of customers to the advantages of a better illumination without increased cost, by well-planned campaigns for the displacement of gas lighting, and programs of renewed solicitation for connecting smaller residences where the oil lamp is still used. The few who would ignore this new lamp on the grounds of its present high price, may be advised to reconsider their condemnation and make a few simple arithmetical calculations involving the relation of lamp cost to illumination cost; until they do this, they are not justified in their adverse attitude, and certainly are not in a position to influence customers to give the new lamp a trial.

The replies appear to indicate a general belief that the price of the tungsten lamp will necessarily remain high. There does not seem to be any real reason for this assumption, though until the processes of manufacture are standardized and labor is thoroughly trained to the new manipulations, the factory costs will naturally be far above the corresponding ones of the carbon-filament lamp, the manufacture of which in recent years has been brought to a wonderful stage of economic production. The material of the new filament is not unduly expensive, and the amount used in a lamp is but a fraction of a grain, which, at the price of gold, would only cost about one cent. On the basis of a labor cost 10 times greater than that of the carbon lamp, the price of the tungsten lamp would not be much more than one-half of its present market price. Finally, there seems to be no probability that a patent situation will exist comparable with that which kept the price of the carbon-filament lamp at a high figure prior to 1891. Plans for the introduction of the tungsten lamp should therefore take into consideration a progressive decrease in cost as makers become more and more familiar with its specific manufacturing requirements. Mr. Freeman also takes up the question of the supply of the new lamp, and in this respect his paper departs from its otherwise optimistic character. With the utmost factory expansion possible, the production for 1908 will not, he states, supply more than 2½ per cent of the incandescent lamp demand of last year; and further, that while the supply of the lamp will increase rapidly, it is certain to be a matter of years before it can be obtained in sufficient number to displace largely the carbon-filament lamp. We cannot, however, agree with the prediction as to the great delay in meeting the full demand for the new lamp. The economics of the case are such, both from the standpoint of central station and consumer, that a price can be paid for the lamp which will make its manufacture highly profitable; and an industry with a capitalization of $1,000,000,000 and an annual revenue of $220,000,000 can, if it chooses, be a powerful factor in shaping to its advantage any situation which involves its interests.

The Engineering of Business.

One of the most interesting developments of the annual program of the National Electric Light Association has been the devotion of at least one full day to the commercial side of the industry. We have already given some details as to the manner in which this part of the work was taken up at Chicago, and our further report, published this week, embodies a good deal of useful data. Possibly to some of our more technical readers it may seem that undue importance has been laid on this general topic and that it occupies too much space, but if they will glance over their own careers and engagements they will perhaps be surprised to note how increasingly their attention has had to be directed to the financial aspects of the operations to which they are daily called as experts. The ideal engineer need not be a politician, but if we gage accurately the whole drift and tendency of the times he ought at least to be an economist, to whom the study of financial and industrial problems is altogether worthy. In the case of the National Electric Light Association there is an extreme appeal to the engineer's friendly interest, for here we have a vast industry trying by scientific methods of commercialism to work out its salvation. The newer capital employed in the art is free in large measure from anterior obligations, but most of the companies and most of the capital are trying by improved business-getting methods and by better selling processes to meet the burden of fixed charges already put upon them by the mistakes and advances of inventors and manufacturers in the past, as well as by the inevitable demands for reconstruction and enlargement. In other words, the "national debt" of the industry has been created quite as much by engineering as by financing, and if the obligations are to be met and extinguished, the engineer must more than ever be competent to give good advice that will help ensure a régime of solvency and profit.

The topics discussed on Commercial Day at Chicago were varied, including the preparation for a business campaign; contract agents and other representatives; the display room; advertising; creating demands for electricity; the evolution of new-business getting; the electrical contractor; illuminating engineering as a commercial factor. The discussions, as was natural, ranged widely over these and kindred points, and brought out a large amount of interesting information. To some extent the perusal of the papers gives the sensation of turning over and over again topics that are rather well worn, but even this is not without its value. As soon as fundamentals are established, one can stop talking about them, and it is evident that in commercial development the central-station systems have still a long way to go. When one company with apparently efficient business machinery is able to hammer only $4 or $5

per capita out of its customers, while another innocent of such formidable organization gets $10 or $11, it is proper that notes should be compared. Moreover, in this arena of test, the Davids that are killing their giants with plain pebbles from the brook are going to earn promotion and permeate the art with new courage and endeavor.

To a certain degree, indeed, there has been a tendency to "force the note" of this commercial development; and it was curious and inexplicable to see in how many instances during the late financial panic business-getting was dropped as though it was a luxury. The benefit of the pause, as of the Commercial Day discussions, was to bring out in high relief, and where they could be assessed, the various advantages of different plans and policies. It is seen that the public is unresponsive to certain appeals and arguments, while others elicit new patronage at every turn. Besides, it is just as well to know when it does not pay to get new business, and there is such a point somewhere, until the plant is lifted to another plane of efficiency and economy and rises once more to the full measure of its opportunity.

BACK TO THE MILL.

During the present week the St. Louis merchants who have been pushing the "Give-us-a-rest-and-sunshine" propaganda, have shown that they are not possessed by any mere theory, but believe that the way to resume is to resume. Hence, they have placed orders for goods to the value of $5,000,000 and many a manufacturer opened his mail on June 1 to find in it the welcome share of this demand for goods. It is needless to say that such a stimulus to production and consumption is opportune; and while you cannot create prosperity by edict any more than you can create intrinsic value by "greenbackism," there is undoubtedly a great deal in the mental attitude and in the point of view. The country being as it is in an essentially sound condition, there is every reason why people should live normally and cheerfully, not seeking wealth and prosperity by self-denial that harks back to the crudest savage barbarism, but by requiring in sensible ways the adjuncts of civilization and exchanging freely that which they can produce themselves for that which others are willing and anxious to give them. The mechanism of credit being restored, trade and commerce can flourish as before.

All signs point to betterment, and most encouraging of all is the renewed opportunity given to labor. It is the artisan who suffers first and most in the deprivation of work and the essentials of life, and to thousands of our fellow citizens the return of prosperity means the abolition of short time schedules and employment where hitherto there was none. But a lesson lingers in the ordeal just endured, and that is the serious incompetency of much labor as the last period of prosperity culminated. It was the universal experience that, never better paid, labor in many lines was never so inefficient; and nothing seemed to cure the evil. The dismissal of whole masses of men, hard as it was in many respects, had at least the remedial effect of throwing off the incubus of labor so costly as to wipe out all possible margin of profit to the producer and employer, and involving extravagant waste of machinery and raw material. We begin the new times of steady work, and business activity, nearer the true economic bases upon which alone real prosperity can be founded.

PROPOSED GERMAN POLICE REGULATIONS FOR THE INSPECTION OF CENTRAL STATIONS.

Recent numbers of German technical journals have published the text of a proposed German police ordinance for the inspection and supervision of electric power stations, under the direction of the German Minister of Trade and Industry, a notice of which appears in the Digest. The ordinance refers in general to all large electric central stations or installations, and in particular to all such stations of more than 1000-kw output capacity. It divides central stations into high-tension stations and low-tension stations. A low-tension station is defined as one in which the effective pressure of distribution between any conductor and ground cannot exceed 250 volts. This would include an Edison 3-wire system of 220 volts between outers, whether insulated from ground or not, and would also presumably include an Edison 3-wire system of 440 volts between outers, if the neutral conductor were permanently grounded. All large installations are called upon to give notice beforehand of their introduction into service, and to require written authorizations, as well as certificates of inspection and tests at periodic intervals from the police department. The expenses of the tests are to be borne by the station or installation, according to an established tariff. A long list of factories is appended to the ordinance, intended to cover all types of factories in which there may be special danger from fire by reason of electric sparks, or in which there may be special danger to persons by reason of electric shock.

The exact provisions for the tests and conditions of a high-tension installation, or of a low-tension installation, are not specifically included in the ordinance; perhaps because if they were, the ordinance, already long, would look like a U. S. Sunday newspaper; but it is to be inferred that the rules are substantially those defined by the Association of German Electrotechnists, which corresponds to our American Institute of Electrical Engineers. The advantage of the ordinance appears to be not merely that it satisfies the German yearning for red tape, but also that it minimizes the responsibility of managers in regard to accidents or injuries. If their installations have been regularly inspected by inspectors carrying the specified number of gold stripes on their arms, and have been duly certified as correct, the range of culpable error in conducting regular business is naturally reduced. The disadvantage of the ordinance appears to be in the opportunity it offers for wearisome inspections with accompanying soreness of heart.

Although it is unquestionably desirable that all installations in our own country should be of the highest practicable type in regard to security of person and property, it is a matter for thankfulness that the inspection and approval of our stations and installations do not lie in the hands of the police. With us the corresponding officer is a fire-insurance inspector or a city electrician in plain clothes and destitute of a night-stick. In Germany, however, the ordinance in question is a natural and appropriate incident to the tacit theory of existence. There, each individual is virtually called upon to show cause and justification for acting in any but the regularly prescribed manner. Here, the tacit theory of existence is that cause and justification must be shown for prescribing the manner in which any individual shall act. The tacit assumption, there, is rigorous adherence to authoritative rule, while, here, it is the inherent right of the individual to do as he likes. The watchword of the one system is order, that of the other freedom. Each has its strong

and weak points. With our esteemed German friends, the advantage of a quasi-military system of life is collective efficiency, capacity for organization, discipline, orderliness and obedience to appointed authority. The advantage of our own method is the stimulus to individual initiative, inventiveness and self-reliance. Our disadvantages are lack of discipline and the liability to the tyranny of unrest. Fortunately for us all, each nation can learn advantageously something from every other.

Telegraph and Telephone Investigation.

The taste for "muck racking" seemed to have lost its edge and zest lately—the result of all overindulgence—and the great public has grown a bit weary of corporate exposure and attack, especially as final research after the first outcry has shown so much of the whole "movement of scandal" to be unwarranted and harmful to the best interests of the nation. It is undeniable that great good has come from the punishment of evildoers in high places, the insistence on respect for the law, and the spread of a higher moral sense throughout the community. But it is felt that with these results the country may well be content temporarily. A warlike position can be maintained, but no man can engage in incessant conflict without repose. One of the greatest English leaders of reform at the beginning of the last century himself coined the phase, "Rest and be thankful," realizing that the work done required its own term of quiet acceptance and interpretation if any lasting good were to come.

Thus, too, with investigation, of which we have had such a ceaseless run the last five years. Just as the period of inquisitorial probing closes, the U. S. Senate starts out again with a resolution calling for an "investigation into all the telegraph and telephone companies engaged in the conduct of an interstate business." As this inquiry is to be made by the Bureaus of Corporation and of Commerce and Labor, it seems well to point out that actual data are already in considerable degree available, and that the census of 1907, required by Act of Congress, will bring such figures up to the hour. If more sensation is the aim, these figures will not suffice, but they are adequate if what is sought for is a sober and useful survey of this great electrical development. In our own State, the same companies are also being subjected to crossfire of this character, by being put under the regulating authority of the Public Service Commission and it would seem that ought to be about the limit. The expense to the authorities and the companies of all this extra work, and the tax upon the bookkeeping staff, is an item that is altogether overlooked, but which must be emphasized in these days of enforced economy.

Daylight and Artificial Light.

In a notable paper presented before the May meeting of the New York section of the Illuminating Engineering Society, Dr. Edward L. Nichols reported the results of numerous tests conducted at various places in this country and abroad, in order to ascertain the quantity and quality of daylight as compared with the light from well-known artificial illuminants. The tests showed a mean annual range in intensity of about 10 to 1 between midsummer and midwinter. Perhaps this fact is not so surprising as the additional observation that illumination in the shade is less for an unclouded sky than for a partly overcast sky. In fact, the maximum daylight illumination occurs when the cloud masses forming within the field of vision reach their greatest density previous to the obscuration of the sunlight. Thus the clouds as secondary sources of light add to the illumination from the sun an amount greater than corresponds to the decrease in sunlight occasioned by their presence.

With regard to its quality, sunlight differs enormously from the light of any artificial illuminant. This result is attributable largely to the higher temperature of the sun—about 6000 deg. C.—as compared with probably 1800 deg. C. of the ordinary carbon-filament lamp, 2000 deg. C. of the tantalum lamp, 2300 deg. C. of the tungsten lamp and 3000 deg. C. of the carbon arc lamp. If the light from each of these sources corresponded accurately with that radiated by a true "black body" at the different temperatures, then the lights from the artificial illuminants would differ among themselves relatively little in comparison with the great difference from the light of the sun. However, daylight is much modified by atmospheric absorption, and the light from artificial illuminants exhibits selective radiation. Nevertheless, the illuminant that gives light having the same quality as daylight, in any of its numerous forms, has as yet not been produced.

Doubtless the higher efficiency of the metallic-filament lamps as compared with the carbon-filament lamp is most largely due to the higher temperature at which they are operated. While it would be improper to state that the limit in temperature elevation has been reached, yet it may well be noted that the possibilities of improving the efficiency by some method other than raising the temperature are much greater than of finding some material that can withstand the higher temperature. The most inviting field for investigation lies among luminescent bodies. Such bodies radiate throughout a contracted portion of the spectrum, and extremely high lighting efficiency can be obtained from a body radiating wholly within the yellow portion of the visible spectrum. Dr. Nichols has expressed his belief in the possibility of combining the radiations from several luminescent bodies so selected as to cover a large portion of the visible spectrum by their overlapping bands, in order to obtain a satisfactory "white light" at the maximum commercial efficiency. This line of investigation, which promises great benefits to everyone, should not be ignored, but should receive the careful consideration of all physicists.

The Complaint Department and the Public.

Of all forms of advertising that may be used by electric lighting companies, probably the cheapest and most effective is a list of thoroughly satisfied customers. The mere fact that a company renders a service of such quality as not to justify complaints does not insure that all of its customers will be satisfied. Indeed, the greatest amount of dissatisfaction may arise from purely imaginary causes, being much augmented when a customer's complaint based solely on suspicion is ignored by the company or treated with contempt. In order to obtain and hold the good will of the public, it is essential for the company to investigate every complaint received and to remove the causes where they exist or to explain satisfactorily that there are not causes when such is the case.

The various causes that lead to complaints from customers, and the methods that may be used to convince the customers of the good intentions of the company, are discussed by Mr. H. H. MacPherson in an article on "The Public Service Corporation and the Public," which appears elsewhere in this issue. The author states that many of the complaints that arise from

high bills are caused primarily by incorrect or irregular readings of the watt-hour meters. Such causes can be eliminated only by the exercise of great care by the meter readers. When a customer receives a bill for one month which is unexpectedly larger than that for the previous month, he naturally becomes suspicious of the company's business methods, and sometimes questions its honesty. A statement from the company that an error has been made in the bill may silence the customers, but it will not remove the possible suspicion that the company has been "caught in the act"—which suspicion, however, can be entirely dissipated by a courteous explanation of the circumstances. It would be well for the company to act upon the assumption that the large majority of its customers are human and expect treatment accordingly; even "chronic kickers" can be quieted by being treated as human beings. The good will engendered by a systematic attitude of this nature on the part of the employees of the company who come in contact with the public is a valuable asset which merits the most careful thought.

STANDARD DIAGRAMS FOR CONNECTIONS AND MACHINERY.

The general plan of standard diagrams, or standard abbreviated representations for well-known forms of electrical machinery and connections, is both convenient and useful. A conventional picture for a shunt-motor, for example, consisting of a certain arbitrary grouping of outlines, is convenient, because it appeals immediately to recognition in a complex diagram. It is useful, because it reduces time and labor in perfecting the sketch, and saves the time-honored legend, *"This is a horse,"* of our juvenile readers. The disadvantage of the system is that when carried to great extent, and to intricate detail, it becomes burdensome to the memory and requires a high priest to make and to expound the sacred symbols. Various schemes by well-known authors have been promulgated in this country for the symbolic representation of switches, lamps, motors, generators, etc., on drawings of electrical installations. A number of such conventional symbols are in extensive use, notably those issued by the National Electrical Contractors' Association.

Our esteemed contemporary, the *Elektrotechnische Zeitschrift*, has recently published a new series of proposed German conventional symbols for such machines and their connections. Conventional form has always held a prominent place in German decorative art. The new German edition of symbols and pictures not only offers a definite conventional picture for, say, a shunt-motor, but it also abstracts the use of conventional letters of the alphabet. Thus the letters A and B denote armature terminals, C and D shunt-field terminals, and so on throughout the alphabet, lower and upper cases combined, not to speak of occasional subscripts; so that no less than 73 letters receive specific technical meaning for use on conventional diagrams. The only complete test of any suggested system is its actual trial, and it will be interesting to see with what success the proposed new edition of conventional symbols will be met. It seems at first sight as though it might be carrying convention too far to impress the letters of the alphabet into special duties, seeing how much general work we call upon them to perform. The demand for specific meanings attached to particular letters of the alphabet, for equations and formulas in technical literature, is much greater than for specific meanings on drawings and blue-prints. There is some hope of our reaching international unity on the use of symbols in technical literature, taking each art and branch of science by itself. It is too much to expect that the letter B, for example, shall be exclusively used to designate a magnetic flux-density, since in mechanics, astronomy, acoustics, steam and other branches of science, both pure and applied, this particular use for the letter B does not occur. Nevertheless, if all electric and magnetic technologists agreed to use the letter in this way, international literature would be correspondingly strengthened.

THE MOTOR-DRIVEN CENTRIFUGAL PUMP.

The merits of the centrifugal pump, which now occupies an important place in engineering practice, are well set forth in this issue by Mr. E. N. Percy, who points out the opportunities for a motor load for central stations presented by the use of such apparatus. The facts that the pump has neither suction nor discharge valves and possesses only one moving part having a continuous rotary motion, and that the discharge is in a continuous stream lacking the intermittent impulses found in the reciprocating pump, are certainly strong justification for its use. It is unnecessary to dwell on the operating advantages of a valveless pump without plungers which need packing, or pistons which require new rings from time to time. When operated at a constant speed, discharge takes place at a pressure which does not increase appreciably even when the delivery pipe is suddenly and completely closed. The pump adapts itself better to some conditions of service than to others, the most economical results being obtained when it is driven at the highest possible speed consistent with safety and low maintenance charges. For pumping clean water, high speed is advantageous, and when gritty water or sewage is handled, a moderate speed is desirable in order to conserve the life of the internal parts of the pump.

The most convenient method of driving a centrifugal pump is by means of an electric motor. Under ordinary conditions of operation, the induction motor is well adapted for this purpose, and a more admirable, rugged and simple combination is difficult to obtain. Both the pump and the motor require a minimum of attention, and high speeds are easily secured by the induction motor, although direct-current motors are used to a great extent. The most important of all services for which the centrifugal pump is well adapted is that of mine pumping, and in the anthracite coal regions motor-driven centrifugal pumps are quite common. Moreover, the centrifugal pump has found a wide use in water works and in fire, hydraulic and boiler feed service. In New York City, three-phase, 25-cycle, 6600-volt induction motors direct-connected to centrifugal pumps are used for the new high-pressure fire service. At present the rating of the motors installed is 15,000 hp, the energy being supplied from central station mains. For various purposes in mills, factories, breweries, soap works, sugar refineries, cement works, etc., the centrifugal pump has found a wide application, and as its smoothness of running and its ability to operate without attention become appreciated, there is no reason why it should not be used exclusively for purposes for which it is especially adapted. In electric generating stations, this type of pump possesses advantages over the reciprocating pump for circulating water for condensers as well as oil for the lubricating system. The larger field for its use is outside the generating station, where the load procurable is ordinarily a desirable one, since in most cases it comes on during the day.

Final Arguments on the Long Acre Application.

At the summing up before Commissioner Maltbie, of the New York City Public Service Commission, of the opposing factions in the matter of the application of the Long Acre Company for permission to issue $60,000,000 stocks and bonds, Mr. Talley, representing the Anti-Monopoly Company, delivered a vigorous attack upon the arguments advanced by the Long Acre Company in favor of its application, asserting that the company was not possessed of a clear title to its franchise and that it had not acted in good faith before the commission. Mr. Talley raised the point that the consent of the stockholders of the Long Acre Company to the first mortgage of $1,000,000, dated Oct. 15, 1906, did not appear anywhere in the proceedings, although such consent is on record in respect to the second mortgage. Also, that there did not appear to be any permit from the old Gas and Electric Commission to make the mortgage as apparently required under Sec. 12 of Chap. 737 of the laws of 1905, which requires that a corporation under the jurisdiction of the old commission shall not increase its capital stock or bonded indebtedness without consent in writing from the commission. Since the proposed issue of bonds would be used to retire the old bonds, by granting the company's application the commission would put the stamp of approval and legality upon the first bond issue. Referring to the Manhattan Transit Company as holding the stock of the Long Acre Company, Mr. Talley quoted Section 13, Chapter 737 of the laws of 1905 which says that no such company shall directly or indirectly acquire the stock or bonds of any other corporation, incorporated for and engaged in a similar line of business. The applicants, he stated, have not brought out new ideas or advanced any sound arguments which prove that the proposed competition would redound to the advantage of the citizens of New York. Passing to the lamp for which the Long Acre Company claimed so much, Mr. Talley said:

"Then their expert makes the most extraordinary statement I have encountered in a long while. He says, 'We are going to use a great lamp.' 'Where is the lamp?' says the commission 'In the laboratory.' Why, Mr. Commissioner, there have been 100,000 lamps in laboratories since the introduction of electricity into commercial use. There is not a laboratory in the country dealing in electricity that has not been experimenting on some form of new lamp. I dare say that the improvement of the lamp has been about the least improvement in the field of electricity that has been encountered. Every electric company in this city, in this State and every city in the Union have been bending all their energies, bringing to bear all the forces and power and genius of the engineers of this country to try and invent a lamp with higher efficiency, and there have been three lamps produced, the Gem, the tantalum and the tungsten. And yet Mr. Knipe says they have a great lamp. He doesn't name it; they have not got a patent on it nor do they control the patent. They admit it is still in the laboratory and, therefore, until a lamp is brought out and tried and proved it might just as well have no existence at all."

The difference of the Edison rate of 10 cents for current and the proposed 8-cent rate of the Long Acre Company would soon disappear, he said, under the system of no free lamp renewals by the latter company. The argument that the new company would stimulate better service was met by the statement that one of the functions of the Public Service Commission was the stimulation of better service, and that the commission would be better able to accomplish that end than the new company, as shown by the recent rate reduction to breakdown consumers and the action of the companies in putting the tungsten lamp within reach of consumers. Mr. Talley challenged the applicants to produce William H. Kelly, who, he said, could prove whether or not the applicants had a just and honest title to the franchise.

Mr. J. S. L'Amoreux summed up for the Long Acre Company and asserted that Mr. Talley's argument was manifestly devoted to the interest of other than the party which claims to have some equitable rights in the franchise under which the Long Acre Company claims to act. The question of whether the applicant has in the past properly conducted its business or whether the securities or stocks issued by it have been properly or improperly used are not subjects of inquiry by the commission, he said. The question as to whether competition would be a benefit was not germane to the subject under investigation for the reason that under the charter and under the franchise the right to operate and the right to create competition are assured. He criticised the Anti-Monopoly Company for not having taken legal action before to prove its alleged interest in the franchise and for waiting until the present company was formed before asserting its claim to the franchise. Speaking to Mr. Talley he said: "How much has your expedition increased over such as you exercised two years ago on that subject? What reason have you for having remained silent and inactive? The fear that you had no claim, and there was none that could be sustained? If you were conscious of right would you have remained quiet as you have? Even if you were conscious of the ability to succeed, would you have remained quiet?"

The hearing was adjourned sine die. The opposing attorneys are to submit briefs within five days as an aid to the commission in preparing its report upon the application of the Long Acre Company.

Overhead vs. Duct Distribution for New York Central.

After having been adjourned for a month, the hearing in the matter as to whether the New York Central should be allowed to maintain its overhead high-tension system was continued before the Public Service Commission on May 22. At the previous hearing, on April 22, the question of the cost of putting the system into ducts was discussed exhaustively. Mr. L. H. Bryan, civil engineer for the railroad, testified that the cost of the first section of conduit installed by the company was 60.8 cents per duct-foot. That section consisted of two separate 32-ft. conduit lines running from the power house to St. Mary's tunnel, with 64 ducts in all. The next section, from Westchester Avenue to Melrose Junction, consisting of two 32-duct lines, cost 65.1 cents per duct-foot. A third section cost 60.3 cents per duct-foot, another cost $1.67 per duct-foot, and another $2.23 per duct-foot. Mr. Hubert M. Bassett, of the railroad engineering staff, gave further details about duct construction and the cost of this class of work, and Mr. Charles T. Martin testified as to his experience with cable burn-outs in duct construction. At the hearing on May 22, Prof. G. F. Sever, of Columbia, said that in his opinion there would be many more breakdowns in cable underground transmission lines than from overhead lines of the type of construction employed by the railroad. Mr. Henry Floy, consulting engineer, said that underground systems at voltages of 11,000 and higher were too common to cause special comment and that high-voltage cables, even in ducts more or less filled with water, are in common and successful use. He said that there is no question that the underground construction is the safer. The overhead system is apt to be brought down by derailments, by storms of wind and by ice, or lightning, since no extra pains have been taken by the railroad to guard against the latter contingency; also, by the possibility of short-circuiting by persons throwing wires over the lines—all of which dangers would be obviated by underground construction. Lightning is a serious consideration and, although no injury has been done as yet to the Central lines, Mr. Floy said that the very next storm might do extensive damage and shut down the system for hours. In the case of strikes aerial lines can very easily be put out of commission by short-circuiting and by breaking the insulators by rifle shots at a distance, and such lines are much more difficult to patrol than in the case of underground construction. In the underground 25,000-volt cables at St. Paul, which have been in operation since 1900, there have been three breakdowns in the paper-covered cable in the terminal heads, eight

in the joints and two in the cable itself, a total of 13. In the rubber cable installed at the same place there have been four break-downs in the terminal heads, eight in the joints, 14 in the cable itself, making a total of 26, with an average of 4 6/10 break-downs a year. In the opinion of Mr. Floy it was decidedly unsafe for the high-tension lines to be below the telephone and telegraph lines, and he added that in spite of testimony to the contrary, he believed that by the use of proper recording instruments defects and breaks in the system could be more readily determined in the underground system than in the overhead service. In case of the overhead wire coming in contact with one of the steel cars filled with passengers, the car would become charged, but resting on ties and dry earth there would probably be no danger unless a passenger formed a bridge between the car and the ground, in which case instant death would probably result. The hearing was adjourned to June 4.

New York Public Service Commission Imposes a Fine.

Through its counsel, Ledyard P. Hale, the Public Service Commission of the Second District has announced that it has served a summons upon the Economic Power & Construction Company, of Buffalo, in an action for the recovery of a penalty by reason of the failure of the company to file its annual report, as required by the statute. The company was informed that if a report was not filed on or before Feb. 10, 1908, steps would be taken to force the penalty of $100 a day, as prescribed by the statute. It has been contended in some quarters that the company is not under the jurisdiction of the Public Service Commission, but officers of the company have requested forms for the annual report and have promised to have the report filed immediately, with a statement in excuse of the delay. The charter granted the company by the Legislature is a very sweeping one and gives permission to operate in any city of the State without requiring permission from local authorities. Because of this the company has already been in the courts, but in Buffalo it won out in a suit brought against it and in Geneva succeeded in having vacated an injunction obtained against it. The courts have also held that the company does not come under the Public Service Commission. The company has claimed that it is not answerable to any company, as its rights are all cited in its charter. John Boyd Thacher was at one time president of the company and is now a large stockholder and John A. Delehanty is the local attorney. If the full amount of the fine is collected, from Feb. 10 until May 26, the date of the summons, the company will be obliged to pay $9,100.

Meeting of New England Section of Illuminating Engineering Society.

The regular monthly meeting of the New England section of the Illuminating Engineering Society was held at the Edison Building, Boston, on May 27, Chairman Codman presiding. The discussion of a problem in department-store illumination from the standpoint of the tungsten lamp, the gas arc and the Nernst lamp formed the program of the evening.

Mr. J. S. Codman presented the first solution of the problem, using tungsten lamps and the minimum possible number of outlets. The store proper consisted of a rectangular room 154 ft. long, 94 ft. wide and 23 ft. high, with counters and cases around the side walls, a three-sided counter in the middle of the room, and an annex at one end, 54 ft. x 60 ft. Interest centered in the illumination of the main store. Mr. Codman proposed using clusters of 100-watt lamps with Holophane clear-glass bowl reflectors, aiming at an illumination of 3 ft-candles at a height of 3 ft. above the floor, or about the height of the counters. The maximum watts per outlet permitted by the underwriters is 660, so Mr. Codman selected six 100-watt lamps as a starting point, working on the principle that the distance between lamps should be twice the height to be illuminated, to give the proper evenness of lighting. The formula applying to the tungsten lamp when equipped with a bowl reflector is, foot-candles = watts divided by the square of the height in feet above the plane to be lighted. By applying this formula and figuring the actual length of floor to be illuminated at 3 ft.-candles as 148 ft., and the width as 88 ft., the height of the outlets came to 14 ft., making the distance between lamps 28 ft. Six outlets would then be needed on the length of the store and four on the width, making 24 total. A spacing of 28 ft. is a little too large, so a practical spacing of 24 2/3 ft. on length and 22 ft. on width would be satisfactory. With this spacing the height becomes 12 1/3 ft. and the necessary wattage 455 per outlet. The lamps are then 15 1/3 ft. above the floor, allowing for the counters. Four 100-watt lamps per outlet would probably be satisfactory. The store has about 17,260 sq. ft. of floor area, giving an energy consumption of 0.63 watt per square foot.

For the windows, Mr. Codman figured 5.5 watts per square foot, but thought that this might be somewhat reduced by lowering the lamps, provided they did not come within the range of vision. Mr. Cowles, of the Boston Edison Company, suggested the use of more outlets and a smaller wattage per outlet to avoid cross lights and shadows, to which Mr. Codman replied that the question of uniformity depended upon proper spacing and height rather than upon the amount of light emitted by each separate source. He selected the 100-watt lamps because of the lower renewal cost in proportion to size.

The gas solution was presented by Mr. Gifford, of the East Boston Gas Company. He advised the installation of outlets every 5 ft. to enable the merchant to change his illumination in relation to changes of the store arrangement. He aimed to secure 3 to 4 candle-feet 3 ft. above the floor, and recommended four-mantle gas arcs with alabaster pear-shaped globes 12 ft. above the floor and 15 ft. apart each way. The gas consumption per hour on the main floor would be 1040 cu. ft., 135 cu. ft. around the stairs and elevators, and 600 cu. ft. in the windows, or a total of 1775 cu. ft.

Mr. Newington, of the Nernst Lamp Company, presented the solution of the problem from his standpoint. For the window illumination he recommended 88-watt single-glower lamps, located 12 ft. above the base of the window and 2 ft. apart. Under all conditions they should be hidden from the line of vision from both inside and outside the store. For the main store he would use the four-glower type in 9-in. alabaster globes, 18 ft. above the floor and 16 ft. apart. For special lighting over the counters he would use 88-watt lamps 10 ft. apart and 10 ft. above the floor. The watts per square foot in the interior of the store would be 1.3, and for the windows 7.3. Two-glower clusters would do well for smaller local lighting.

Automatic Control of Machine Acceleration and Retardation.

For many years past there has been an increasing tendency to operate, by means of directly connecting electric motors, heavy reversible machinery, such as mining hoists, metal rolls, planers, etc. In many instances the acceleration or the retardation, and in some instances, such as planers, the acceleration and reversal are automatically controlled.

In the case of large mining hoists, for example, the control is so arranged in many instances that the operator has merely to close a switch and the hoist is then automatically accelerated to full speed, and continues to run until the end of the lift is reached, when it is automatically retarded by causing the motor armature to generate a braking current, so as to bring the hoist to rest at exactly the right place.

In recent planer practice the planer bed is automatically accelerated, retarded, reversed, and accelerated again on reverse stroke, and so on, the entire cycle of the operation being automatically effected by automatically controlling the motor.

A patent (No. 888,447), dated May 19, 1908, has been issued to Mr. H. Ward Leonard which is directed to the automatic control referred to. The patent is based upon an application filed by Mr. Leonard in the early part of 1897, and will interest engineers giving attention to the line of work indicated.

Electrical Decorations in San Francisco in Honor of the American Fleet.

The arrival of the Atlantic fleet in San Francisco Bay was the occasion of special electric illumination in San Francisco and other cities on the Pacific Coast. San Francisco was decked in national colors and emblems from the Ferry Building to Twin Peaks, and from North Beach to South San Francisco. Market Street was decorated more lavishly than any other street in the city. From the Ferry Building to Van Ness Avenue poles were set at intervals of about 75 ft. Flags floated

FIG. 1.—SIGN ON TELEGRAPH HILL.

from the tops of the poles and from shields at the centers and festooned from pole to pole were strings of 16-cp lamps spaced 4 ft. apart on No. 16 and No. 14 rubber-covered wire. At the Ferry Building the festoons terminated in a huge red, white and blue shield, which at night was brilliantly illuminated by lamps of the same colors. The shield was 40 ft. wide by 50 ft. high and contained 1858 incandescent lamps of 8 cp spaced about 2 ft. apart. The tower of the building was outlined with over 2000 lamps and a very pleasing effect was obtained in the long nave of the building, where the arches were outlined by means of red, white and blue lamps. At the ends of the nave small concentric arches were placed, thus giving an appearance in perspective of a very long thoroughfare.

Union Square was brilliantly lighted by incandescent lamps hung in Chinese lanterns. Across the square the St. Francis Hotel was outlined with lamps and with a searchlight and incandescent clusters on the roof. Chinatown was a fantastic

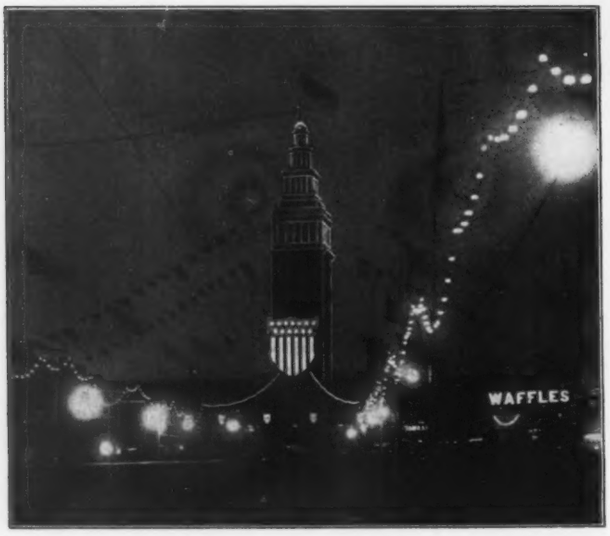


FIG. 2.—LOWER MARKET STREET AND FERRY BUILDING.

glitter. The two principal bazaars were brightly illuminated to the tops of their pagoda towers and the chief thoroughfares had festoons of incandescent lamps suspended in brilliant Chinese lanterns. On Fillmore Street the display was unique. The four-part arches with their rows of incandescent lamps, which are a part of the permanent illumination of the street, formed a basis for more extensive decorations, which included fighting tops erected on the telephone and trolley poles, with little guns threatening the passerby.

The most conspicuous single feature of the illumination was an immense sign of "Welcome" built on Telegraph Hill, facing south and east and overlooking the entire bay region. This sign, built at an elevation of several hundred feet above the bay, threw its illumination for a great distance and was legible at all points on the bay, even at a distance of 30 miles. It was easily read in Berkeley, 10 miles distant. This sign, which is said to be the largest electric sign in the world, is 400 ft. long and the height of the letters is 50 ft. The average width of the letters is 38 ft., the width of the sections of the letters being 8 ft. As a basis for the frame long piles were driven 20 ft. apart. These were planted 3 ft. in the ground and varied in length from 53 ft. to 80 ft. At the highest point of the hill the lowest cross-timber of the sign proper was placed and 20 ft. above this another cross-timber with diagonal bracing in between. Above this were placed three parallel horizontal stringers, 10 ft. apart. All timbering outside of the piles was 4 in. x 6 in. The letters were constructed on these string-

FIG. 3.—ILLUMINATION IN CHINATOWN.

ers of 1-in. boards, 12 in. wide, painted white. A double row of lamps was run around each letter, spaced 18 in. from the outer edge and 5 ft. center to center. The lamps were spaced 3 ft. apart and were wired on the face of the letters with No. 12 bare copper wire, supported by porcelain knob insulators. Nearly 700 32-cp lamps were used. These were operated on a 110-volt circuit, fed by two 75-kw transformers, the energy being donated by the San Francisco Gas & Electric Company. A running board was placed along the top from which a boatswain's chair was swung for installing the lamps. The sign was illuminated each evening from 7:45 p. m. to 1 a. m. from May 6 to May 18, when the fleet departed for the north. In the construction of the sign 48,300 ft. of lumber was used, 160 turn-buckles and 18,000 ft. of ½-in. galvanized-iron, stranded guy wire. A donkey engine was used to hoist the material to the top of the hill. The sign was built to withstand the heaviest gale and has successfully withstood a velocity of wind that reached 92 miles an hour farther out in the shore. The sign was constructed at a cost of $2,850 by the Martland Electric Company and T. A. Pettus, of San Francisco.

A feature of the decorations in Oakland was a large canopy of incandescent lamps suspended over the junction of Fourteenth Street, Broadway and San Pablo Avenue. From a large centerpiece strings of red, white and blue lamps were run to the corners of the streets. Lamps were also strung along all the principal streets of the city.

Although the illuminations on land were extensive, by far the most attractive was the lighting of the fleet itself. The 27

battleships and cruisers, as they lay at anchor south of Goat Island, were illuminated nearly every night, the lights outlining the ships entire. Every spar and stack was outlined and the name of each ship shone forth in large electric letters across the boat. From 8 to 8:30 p. m. on several evenings further illumination was afforded by the searchlights throwing their beams about the bay and adjacent hills. The electrical display on land and water was a magnificent and memorable one. The power companies joined the merchants in furnishing energy gratuitously, and everyone vied to do his share in the welcome to the fleet.

Electric Railway Engineering Laboratory at the Worcester Polytechnic Institute.

A prominent feature of the recently completed electrical engineering building of the Worcester Polytechnic Institute is the electric railway equipment, which occupies one end of the large general electrical engineering laboratory. Two tracks connecting with the tracks of the local street railway and, in that way, with the suburban and interurban railways of New England, enter the laboratory on space covered by the traveling crane for its entire length. One of these tracks passes over an inspection pit. The second track enters to a testing plant, where a car or locomotive under test rests and runs on wheels carried by axles which transmit the power from the car to special electric absorption dynamometers and fly-wheels. The pedestals carrying these axles may be moved to accommodate cars of any truck or wheel base, and the fly-wheels are so arranged that their weight may be changed to correctly imitate the linear inertia of cars of any weight within wide limits. The car under test is held in place over the supporting wheels by being coupled to a securely anchored end post. This coupling may, for certain tests, include a traction dynamometer.

A portion of the equipment is a double-truck, four-motor interurban car, designed particularly for experimental and testing work, although conforming as closely as possible to standard lines of construction. This car is fully equipped with special apparatus, and is available for experimental and testing work, either on the test stand in the laboratory or on the lines of any electric railway. While on the test stand, the car may be operated by means of its own "K-28" controller, or from either the type M, General Electric, or the electro-pneumatic Westinghouse controller, both of which are mounted on racks at one side of the test plant. The air brakes may be controlled from the motorman's valve on the car or from a duplicate outside.

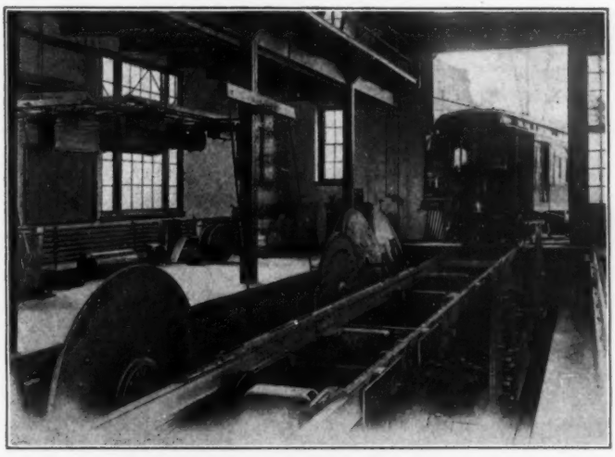


FIG. 1.—CAR-TESTING EQUIPMENT.

The set of recording instruments, which is an important feature of the equipment, was designed and built at the Institute by members of the department who have had wide experience in railway testing. These instruments are capable of making a complete autographic record of car or locomotive tests, and may be shifted quickly from the Institute car to any other. In connection with the Institute car, they are arranged to give an autographic record of the clerical conditions (of bonding, feeder drop, etc.) of any line over which the car may be operated.

In addition to the railway equipment above described, the laboratory is provided with various types of railway motors, controlling, braking, lighting, heating and signaling apparatus,

FIG. 2.—GENERAL VIEW OF LABORATORY.

mounted in operative condition, and available for study or tests.

The general laboratory contains a 300-hp motor-generator, from which energy may be obtained for railway testing. The generator of this set is really a double-current machine which may be used as a rotary converter in regular railway substation service.

Power Development at York Haven, Pa.

Improvements that will require the expenditure of more than a half a million dollars have been started by the York Haven Water & Power Company at its power plant on the Susquehanna River at York Haven, Pa. These improvements will consist of the building of an addition to the power house, installation of hydro-electric units, the building of a dredging machine, strengthening the power dam, and the installation of new machinery. The work will be under the supervision of Mr. E. F. Baker, superintendent and general manager.

Several hundred men have been put at work and it is expected that the work will be completed in about one year. The addition to the power house will be 280 ft. long and two stories in height. It will be constructed of brick.

Ten generators will be installed by the General Electric Company, and these will increase the electrical output 10,000 hp. The 20 waterwheels required to operate the generators will be installed and set up by the Poole Engineering Company, of Baltimore, Md.

The improvements to the dam will make it one of the finest pieces of masonry in the country. The stone to be used in this construction is to be taken from the company's quarries. A $15,000 dredging machine is being set up and will be used to keep down the sand and gravel bars which form from time to time near the cribbing. The company's stone quarry, which is one of the best in the section, will be equipped with an electric crusher which will have a maximum capacity of 600 tons every 10 hours.

With these improvements completed, the company proposes to extend the present high-tension lines to Lancaster and other cities in Lancaster County, and to Spring Grove and Hanover. The demands made on the York Haven Power Company from numerous manufacturing plants have necessitated these improvements.

Lightning on a 72,000-Volt Transmission Line.

Mr. F. E. Greenman, in a paper before the Chicago section of the A. I. E. E., May 22, gave some interesting observations as to lightning on a 72,000-volt line of the Grand Rapids-Muskegon Power Company between Grand Rapids and the two power houses of that company. The majority of interruptions to service, he stated, were due to lightning. The pole line has a continuous grounded wire for lightning protection, and the transmission wires are placed two on a lower cross-arm and one on a short upper cross-arm. On the other end of this upper cross-arm is the grounded wire. He did not speak at all favorably of the grounded wire as a lightning protection. In some cases lightning would strike the transmission wire located below the grounded wire. He could not detect that the grounded wire had taken any discharges. Apparently the most satisfactory operation of the line has been obtained when no lightning arresters were connected at the terminals. With no lightning arresters in use, the discharges would enter the substations, but would do no damage. With lightning arresters discharges would sometimes jump to the walls. In cold weather static discharges affect the pins; these are of wood, simply boiled in oil and are destroyed rapidly. Creosoted maple pins are being put on all cross-arms, and these give good service.

Handling Tungsten Lamps at Brooklyn.

Mr. M. S. Seelman, Jr., of the Edison Electric Illuminating Company, of Brooklyn, N. Y., in a discussion at the National Electric Light Association convention, gave an interesting account of the way tungsten lamps are being handled in Brooklyn. A separate company, the Tungsten Lamp Specialty Company, was organized to exploit the tungsten lamp, and especially the 100-watt lamp, among gas consumers, with the clear understanding that it must pay its own way. As it was displacing gas burners that this new company was after, it was deemed advisable to present prospective customers a unit price covering the complete tungsten equipment, including wiring, fixtures, reflectors and lamps. It was not deemed wise for the Tungsten Company to do its own wiring because of possible ill will of contractors. Specifications were drawn covering wiring in molding for a minimum of four 150-watt lamps, not more than six lamps on any one circuit, with a separate switch for window lights and a switch for each circuit, the contractor to hang fixtures, which were to be furnished by the company. These specifications were submitted to the leading contractors in Brooklyn and resulted in the Tungsten Lamp Company securing a blanket price of $2 per outlet and 50 cents per switch. Types of single-lamp fixtures were adopted which cost the company from 45 cents to $1.20, according to style and length of stem. A specific type of reflector was adopted as a standard for general use. The price of the 100-watt lamp when sold separately was fixed at $1.75.

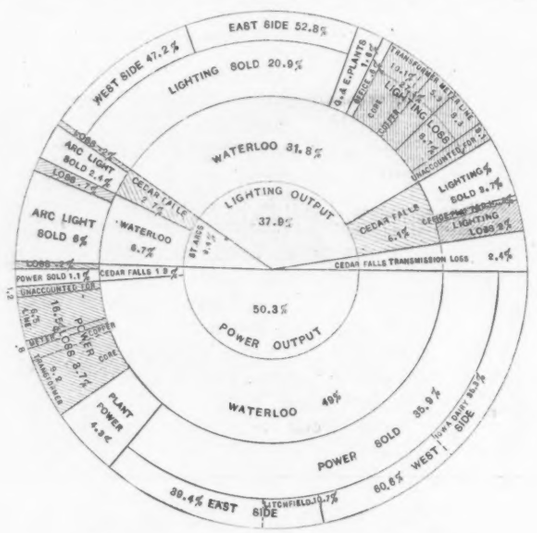
The proposition of the Tungsten Lamp Company advanced to the public was to supply a complete equipment for $7.50 per outlet, including as aforesaid, wiring, fixtures, reflectors and lamps. This price allowed about $2.50 per outlet for office and sales expense. Of course, it was understood that the standard fixtures and reflectors would not suit every installation, and solicitors were furnished with pictures and prices for other fixtures and reflectors. Five solicitors were employed and each one was supplied with a simple kit, consisting of a neat satchel enclosing sample fixtures, reflectors and 100-watt lamps. These solicitors were instructed to let exclusive electric installations severely alone and to confine their efforts as far as possible to stores illuminated altogether by gas. They were also permitted to solicit business in stores partially illuminated by electricity and partly by gas, provided they could put the gas out of business. Business was to be done as far as possible for cash, but installments spreading payment over not more than six months might be accepted where credit was good.

The Tungsten Company has been operating on this basis for about seven weeks, and during that time has secured 50 contracts covering the installation of 312 tungsten lamps. Of these, 42 contracts replaced installations exclusively gas, while eight replaced gas installations partially electric. It is exceedingly pleasing, as well as unusual, to find so many satisfied customers, for in each case the customer is delighted not only with his illumination, but with his bills. The company has given all customers the option of renewing burned-out lamps for $1.75 per lamp or of having the company maintain the installation at 35 cents per month per lamp, which is a guarantee of five months' life. So far 15 customers, with 97 lamps, have taken the maintenance proposition. The others assumed the risk themselves.

Breakage in shipment and handling is very small. The number of defective lamps so far is greater than was anticipated. The majority of lamp failures have been due to faults of construction in the lamp itself. Out of 774 lamps installed, 21 per cent failed and broke, the large majority going out after burning from 10 minutes to 24 hours. The principal trouble seems to be with defective vacuum. On May 1 the Edison Electric Illuminating Company announced to the public its policy regarding tungsten lamps and offered the 100-watt lamps at $1.50. The Tungsten Lamp Specialty Company on the same day also reduced its price to $1.50 and its equipment figure to $7.25 per outlet. The Tungsten Company has handled incidentally some 60- and 40-watt lamps, but its main effort is directed toward the sale of 100-watt lamps. Although in business such a short time, the tungsten company has been able to pay its own expenses.

Analysis of Output at the Waterloo (Ia.) Central Station.

By the courtesy of Mr. Austin Burt, general superintendent of the Citizens' Gas & Electric Company, which supplies electric light and power to Waterloo and Cedar Falls, Ia., we are enabled to present the accompanying chart showing the output of this company's central station for various purposes in 1907. This chart indicates graphically the output of the central station for various purposes and the relation of energy generated to energy sold. The relative amounts of energy generated and sold for various purposes are graphically expressed by the arcs of circles. The areas enclosed have no relation to the percentages shown.



ANALYSIS OF CENTRAL-STATION OUTPUT.

This chart is of much interest because it is seldom that a central station serving a population of about 25,000 inhabitants makes such a complete analysis of output and losses in such convenient form as is here shown. The system is one which is

maintained at a state of efficiency better than the average, so that the figures given probably represent as good results as can ordinarily be expected in plants of this size. From this chart it is seen that 50.3 per cent of the total output of the station is for power purposes, which is unusually high, and shows the effect of securing a large amount of manufacturing load. Of this power output 49 per cent goes to Waterloo and 1.3 per cent to Cedar Falls; these percentages being expressed in percentages of the total output, except in the case of the losses, which are in percentages of output for each class. Of the power delivered to Waterloo, 35.9 per cent of the total is sold; so that the ratio of power sold to power generated for Waterloo is about 71.5 per cent. The lighting energy generated for Waterloo is 31.8 per cent of the total and 20.9 per cent of the total is sold, making a ratio of lighting current sold to lighting current generated of 65.5 per cent. For Cedar Falls, which is a town of about 5000, as against 20,000 population for Waterloo, the ratio of lighting current sold to current generated is 61 per cent. There are many other interesting conclusions which a study of the chart will show.

Discussion on Lightning Protection at N. E. L. A.

Following the report of the committee on "Lightning Protection," presented at the National Electric Light Association in May, a discussion took place at which the following were some of the points brought out:

Mr. Farley Osgood, of Newark, inquired whether it was the intention of the committee to recommend the installation of a small single-cell aluminum arrester to protect meters, as suggested in the committee's report. Mr. R. S. Stewart, chairman of the committee, said that this was hardly a recommendation because he did not know whether the manufacturers had developed a cheap enough arrester at the present time for this purpose. Mr. Osgood said he did not doubt that the manufacturer would be delighted to make all that could be used, but he would rather take chances on a meter burning out than bother with an arrester in connection with it.

Mr. Alex Dow, of Detroit, said that when he was a member of the lightning protection committee, complaints made proved that damage to meters is an exceedingly annoying, if not expensive, item. If the line is reasonably well protected at its ends, or at various points which seem to be specially subject to lightning damage, it is certain that all of the meters on the secondary circuit will be reasonably protected.

Mr. Arthur S. Ives, of Poughkeepsie, spoke of the conflicting testimony regarding the efficacy of overhead ground-wires for lightning protection. In some places the use of overhead ground-wires is almost unknown. It has been shown in the statements before the N. E. L. A. and the A. I. E. E. that there may be a considerable theoretical value in overhead ground-wires. Certainly they will give the necessary protection if enough are put up. The question is, if one wire is good, what percentage of the total value is attained thereby?

Dr. C. P. Steinmetz said that an aluminum cell in shunt with a meter is not a mere shunt, but is a short-circuit for excess voltage, and an open circuit for normal voltage so it does not waste an appreciable amount of power; not more than two or three watts at the highest. He cited a case where meters near a wireless telegraph station were burned out whenever the station was operated. He recommended putting two aluminum rods in an ordinary tumbler, filling it with the proper electrolyte and connecting it across the meter. When this was done there was no further trouble. Wireless stations create an electrostatic field somewhat similar to lightning. Regarding overhead ground wires, the nearer one obtains a complete cage around the wires, the better will be the protection. Dr. Steinmetz expressed the opinion that one cannot connect to ground too often. He suggested a ground connection at every pole. The lightning arrester ground circuit need not have the low conductivity of a ground connection for a secondary circuit. On grounded secondaries the ground connection should have as low a resistance as possible, so that in case of a cross between the primary and secondary circuits, the ground circuit can pass almost any current without a serious rise of potential between the circuit and the ground. Therefore, it is very desirable to carry the ground wires to a system of water-pipes or a rail return, even if at a considerable distance. A lightning arrester ground connection will be nearly as safe with a high as with a low resistance, but it is of the utmost importance that it be of the least possible impedance. This condition requires the shortest possible pass from lightning arrester to the ground and a conductor of as large surface as possible, the material of the conductor being of secondary importance. Iron is practically as good as copper, for with these very high-frequency discharges the discharge occurs only at the very surface. Iron pipes driven in the ground will be more effective than a first-class low-resistance ground carried to rails or copper plates. Dr. Steinmetz stated that he had made some study of the ordinary pipe ground-connection, taking daily records for some years, and he believes that a number of ordinary pipes driven into the ground in multiple are really the most effective ground for lightning. The simplest way to guard against ground-pipes becoming dry is to drive them in a lawn. As long as the grass is green the ground is moist and the condition of the grass is a continuous indication.

Regarding the relative amount of protection afforded by a single ground wire, he stated that if a single grounded-wire is so placed that all of the current-carrying wires are included within an angle of 60 deg. below the ground wire, the single ground wire will give most of the possible protection—perhaps 75 per cent or more. He would install additional wires only where special danger exists. For instance, when crossing the summit of a range of hills, especially when it is crossed not exactly at the summit, but a little toward the slope, from which thunderstorms generally come. Moreover, in cases where transmission lines pass along a lake or ocean with the prevailing winds coming from the water, a ground-wire is needed on the side of the line toward the water. In general he thinks a single ground-wire protection of good conductivity is sufficient for all except special cases.

Mr. Alex Dow, of Detroit, gave a specific case of a single overhead ground-wire proving valuable. A 4600-volt three-phase transmission line supplying energy to factories was especially susceptible to lightning. At every transformer there was a lightning arrester. The lightning preferred to puncture the transformers, short-circuit the terminal boards and even to jump to the grounded transformer case rather than to go through the arrester, which was grounded over the same wire. This line gave serious trouble for one summer and part of another. It ran a distance out from the city, so that it was not protected by surrounding buildings and trees. This line has been thoroughly protected from lightning for several years by a single ground-wire connected to earth at every tenth pole, this ground-wire being strung on the top cross-arm along with one of the three-phase wires. On other similar lines running into exposed areas beyond the protection which was surrounded at all times by a dense growth of trees, the same construction was found highly effective.

Meeting of New York Electrical Society.

The 277th meeting of the New York Electrical Society was held Wednesday evening, May 27, at the College of the City of New York, now located on Amsterdam Avenue, between 138th and 140th Streets, and was well attended, many ladies being present. Preceding the lecture of the evening an organ recital was given in the auditorium by Prof. S. A. Baldwin. The audience then proceeded to the Assembly Hall in the sub-freshman building, where a paper was read by Mr. F. L. Gilman on "Modern Telephone Apparatus and Its Manufacture." Mr. Gilman discussed some of the fundamental conditions peculiar to the telephone industry, tracing their effects through the design and manufacture of telephone equipment. The various phases in the development of modern forms of substation and central-station apparatus were reviewed and several interesting points

in the effect of the telephone were touched upon. The lecture was illustrated by lantern slides, and there was a very complete exhibit of apparatus, showing the development of the various instruments from their earliest forms to the modern standards.

After the lecture the party was conducted on a visit of inspection through the various buildings.

Commercial Sessions at the N. E. L. A. Convention.

Business-getting methods were discussed at the recent Chicago convention of the National Electric Light Association according to a "Commercial Day Program" which was prepared by Mr. C. W. Lee. The carrying out of this program required the whole of the afternoon of Thursday, May 21, and the morning and afternoon sessions of Friday. Brief abstracts of the special papers which were prepared by various editors and assistants for the commercial sessions are given below.

PREPARATIONS FOR A CAMPAIGN.

A general outline of the organization and work necessary to accomplish the best results in the sales department, with the least expense or investment, was prepared by Mr. Henry J. Gille as editor, with a corps of 12 assistants. The method by which the work of solicitors can be assigned to best advantage, and the rates that should be paid for obtaining new business were fully discussed. It was suggested that the customers' accounts should be classified so as to determine along what particular line the business is developing. There should be a record of business lost, together with the reason for loss. Careful attention should be paid to complaints; efforts should be made to ascertain if the service has been satisfactory after each complaint has been investigated.

THE CONTRACT AGENT AND THE REPRESENTATIVE.

Mr. V. A. Henderson, as editor, and 24 assistant editors, presented a paper dealing with the qualifications and duties of the one who has charge of the relations between the public and the company. The work which should be performed by specialists and not by the general solicitor, is that dealing with motors, signs and illuminating engineering. Certain duties may well be assigned to women representatives, such as the introduction of domestic devices.

THE DISPLAY ROOM.

The value of maintaining a display room and the methods for arranging display apparatus were treated in a paper due to the combined labors of Mr. L. D. Mathes, as editor, and 13 assistants. It is essential that the apparatus be arranged for a working demonstration of each device displayed. Where possible, the display room should be located in such a manner that customers will pass through it in visiting the business office. In the majority of cases reported the display room embraces the window space as well. On this account it is regarded by some that the window display is the keystone of the arch—that the brightest and most attractive exhibits should be made in the windows, that the same may attract the attention of those who pass.

ADVERTISING.

Mr. Charles A. Parker, as editor, and five assistants, presented a paper on "Advertising," compiled from information obtained from a large number of central stations. In arranging for the paper the editors sent a list of 24 questions to 138 central stations and received complete sets of replies from 54. These questions were intended to bring out points believed to be of value to all central stations. The opinion was expressed that the advertising and marketing of electricity are on a par with the advertising and marketing of any other commodity that can be named.

PUBLICITY.

The relations of the central station with the public were discussed at length in a paper entitled "Publicity," prepared by Mr. Percy Ingalls, as editor, and eight assistant editors. It was claimed that there has been no definite reason for secrecy in the operation of public-utility companies, while numerous advantageous results follow the taking of the public into the confidence of the company. A popular form of publicity has been through the medium of daily talks in fair-sized newspaper display space. In this space the company has been able to explain its methods, tell the object of its existence, and handle a mass of interesting facts and figures, thereby creating renewed interest in the operations of the company. If this copy is handled in a sincere way it becomes productive of untold good. There should be popular talks upon illumination, cooking and heating, dinners to contractors, boosting the city, advertising the installation of large motor units or additions to plant equipment, cultivation of friendship with the newspaper men and the furnishing of live news stories to the papers.

CREATING DEMANDS FOR ELECTRICAL ENERGY.

A paper recording examples of methods that have been applied successfully in producing demands for electrical energy was prepared by Messrs. Frank B. Rae, Jr., and George Williams, as editors, and six assistant editors. The object of the paper was to cause electrical salesmen to realize their opportunities and their ability to create opportunities. Street lighting, electric heating, industrial motor and decorative lighting were characterized as businesses of the "created" type.

EVOLUTION OF NEW-BUSINESS BUILDING.

Opportunities for creating business along existing lines and examples of central stations that have continued methods during depression were discussed in a paper presented by Messrs. George N. Tidd and Duncan T. Campbell, as editors, and 13 assistant editors. In registering a plea for the maintenance of commercial departments and advertising, it was stated that there is no surer way to produce and increase hard times than to cease the effort to secure additional business. The opportunity to obtain additional business with the least investment is greater at this time than ever before, from the fact that the demand already created gives a better chance to place additional equipment than in the past.

THE ELECTRICAL CONTRACTOR.

Specific examples and general discussions of what electrical contractors are doing to assist in creating demands for electrical energy were given in a paper prepared by Mr. Joseph F Becker, Jr., as editor, and 9 assistant editors. It was claimed that in view of the fact that the contractors are particularly well equipped to solicit business from a certain class of possible customers for central-station service, it would be a wise policy to encourage such solicitation in every possible way. In order to bring about closer relations and to offer instruction of a kind that would assist the contractor in advocating the use of electrical energy for various purposes, the central station could profitably give lectures or informal talks at frequent intervals, to which all contractors should be invited. The regular distribution of printed matter, such as would be of assistance to a solicitor, would afford a means of familiarizing the contractor with the arguments used by the central-station solicitor when recommending the use of electrical energy for any particular purpose.

ILLUMINATING ENGINEERING AS A COMMERCIAL FACTOR.

A paper dealing with the importance of illuminating engineering as a commercial factor as proved by the experience of central-station men from different parts of the country was presented by Mr. V. R. Lansingh, as editor, and 12 assistant editors. The application of good illuminating engineering principles results in benefit to the central station by giving the customer the maximum amount of illumination for the lowest expenditure of money possible, a sentiment is created in a community which will successfully resist the efforts of competitors to break in on what should be a monopoly, and at the same time still the oft-heard cry of municipal ownership.

Moreover, by giving to a customer satisfactory illumination at a reasonable figure the central station will obtain a better load factor. There will be an increased use of electric light by the old customers, which in itself will react and increase the number of customers.

Discussion of "Commercial Day" Papers.

QUALIFICATIONS OF THE CONTRACT AGENT.

Mr. W. E. Turner, of Cleveland, in a discussion presented during the Commercial Day program, emphasized the importance of a knowledge by the contract agent of men and conditions. By knowledge of his own men he will place them in positions best suited to their capabilities and tastes. Knowledge of customers will tell him whether they are worth working upon. He should so organize his force that it works more or less as a machine. He considers that there is no doubt that better work may be accomplished through a machine-like organization of young, pliable, intelligent minds than by the more or less independent and loosely-controlled highly-developed representatives. He does not favor elaborate detailed reports concerning the movements of the district and special representatives. He thinks the best field for the woman representative is in the sales department offices. The work of meeting customers with complaints, selling heating and other appliances, selling lamps, taking applications and all the work which deals in the majority of cases with the small customers who come to the office, is dissatisfying to a man, but seems eminently suited to a woman's taste.

Mr. Harold Almert said that in one company with which he is connected an illuminating engineer is employed in the meter department, in the belief that a great many complaints on meters are not due to the meters at all. In 7 cases out of 10 the troubles were found to be due to poorly designed lighting installations or badly located fixtures.

Mr. Alex J. Campbell, of New London, Conn., outlined a plan for promoting the sale of electrical appliances by purchasing them in quantities and getting the local merchants handling similar lines of goods to sell them. For example, one or two hardware stores will be given a supply of electrical appliances that might be sold in these stores. The same thing will be done with drug stores. The central station, which will carry the stock, will fix on it a price which will give to these dealers a fair profit. The dealers will get all of the money that is made in the sale of the appliances. The company will not be making any money out of appliances sold in that way, but Mr. Campbell says he would rather forego that profit than spend several dollars to sell each appliance, as he did last year. He would welcome the day when electric appliances are sold as freely and readily as pie plates and patent medicines.

Mr. H. W. Hillman told of the electrical show held at Grand Rapids during the previous week. Out of the 100,000 people in Grand Rapids he estimated that from 10,000 to 20,000 attended the show. From the comments in regard to it he was satisfied that many of these people will attend next year. Such a show requires a high degree of co-operation between the central station, the contractors, the dealers and the people.

BUSINESS GETTING AND HOLDING.

The following points were brought out in a discussion on "Getting and Holding Business." Mr. J. T. Maxwell, of Philadelphia, urged the necessity of investigating carefully the causes for disconnections in order that the percentage of business lost to business gained be as small as possible. There are certain natural losses, such as failures, fires and going out of business. Leaving these natural losses out of account, the other losses must be carefully watched. This is as important as securing new customers. The solicitor who brings in many contracts because he has made promises and guarantees which the company later on finds difficult in carrying out, leaves behind him a trail that may take many months to counteract. In fact, his employer may never know the amount of damage he has done to the company's reputation.

Mr. F. M. Tait, of Dayton, emphasized the proper handling of complaints. One cannot expect to get all of the business available in any locality unless every complaint is properly and satisfactorily handled. One company employs a very expert complaint clerk whose business it is to see that every customer who leaves the building is thoroughly satisfied and happy.

Mr. R. M. Searle, of Rochester, N. Y., said that his company took in $445,000 of additional gross earnings last year at a cost of $60,000 to get it, the rate of increase being three times as great as during the year previous.

Mr. Farley Osgood, of Newark, N. J., said that one of the greatest difficulties in complaint work is the fact that the representative of the company to whom the customer makes the complaint usually assumes that there is no justifiable complaint. Better progress can be made with customers by sympathizing with them and trying to see their side of the proposition, and by assuming that if there is no just ground for complaint they would not make it. The feeling of the customer when he enters the office that he will not receive any sympathy is one of the surest elements of continued dissatisfaction.

Mr. Arthur Williams, of New York, referring to the apparently high percentages of disconnections reported by some companies, called attention to the fact that the disconnections included all those of persons moving from one place to another. Therefore, many of them do not represent loss of business, but simply changes. Valuable comparisons can be made by dividing business into different classes and determining the relative cost of securing different classes. The cost will be found to vary from five cents or even less per 50-watt lamp or equivalent connected, to perhaps $1. A complaint should be looked upon as an opportunity to get better acquainted with a customer, and to cause him to become better acquainted with the central station man.

Mr. M. S. Seelman, Jr., of Brooklyn, described an experiment that the company has been trying in Brooklyn with its 1500 employees. The officers felt that many of the men might be used to advantage in securing business. A school meeting one night a week was established in which it was offered to teach the employees all of the practical requirements for securing business, lamp practice, details of contracts, methods of estimating expense, etc. As a result, there are now many solicitors who work in the evening, or when not otherwise employed by the company, each one having a local coterie of merchants from whom he is able to secure business which might not otherwise be obtained. On all contracts for new business the commission is 50 per cent of the first full month's bill. No extension business is taken on this basis. Some complications have arisen, and certain modifications are required, but in its main essentials it is a part of the company's practice and will survive.

Mr. Searle, of Rochester, said that it is a good plan to keep in touch with the advertising of "Motors For Sale" in the daily papers. Frequently a man has an idea that he will discontinue the use of a motor before he really intends to sell it, thereby giving the company an opportunity to ascertain why he wants to sell it.

Mr. J. S. Cartwright, of Knoxville, Tenn., emphasized the necessity of distinguishing between profitable and unprofitable business. He thought too much attention is paid by the ordinary run of solicitors to obtain the maximum number of kilowatts connected at the end of the month. The load factor should always be kept in mind. During the past year his company's load factor increased from 26 to 38 per cent; for the three months of the present year, while the gross income has shown a slight decrease, the net income has represented a small increase.

Mr. C. Osborne, of Spokane, Wash., gave some figures on the cost of getting business in Spokane. His report for the last half of 1907 shows that of the total expense incurred by this department, 45 per cent was paid for salaries and bonus, 10 per cent for advertising, 5 per cent for miscellaneous expense, 29 per cent for free work on signs, 11 per cent for free wiring. The cost per call was 84 cents. The cost per order, personal, $8; cost per order, gross, $5; cost per $1 revenue, personal, 15 cents; cost per $1 revenue, gross, 10 cents; cost per $1 revenue, net, 13 cents. Percentage of expense to increased net revenue, 15; percentage of orders, personal, 62; percentage of revenue, personal, 71. Number of calls per order, 9.

Relationship Between Central-Station Engineering and Commercial Departments.

In a paper read at the Chicago Electric Light Convention, Mr. L. A. Ferguson presented the importance of a close co-operation between the engineering and commercial staff of central stations, and set forth the advantages of technical knowledge to those engaged in the management of such properties.

In some quarters, he said, the lines of organization are drawn so hard and fast that there is little or no intercommunication between the engineering and the commercial sides of the business, resulting, perhaps, even in actual opposition and lack of respect one for the other arising out of lack of knowledge of each other's value.

Such a condition is exceedingly deplorable, and there should be no excuse for its existence. This criticism does not imply any advocacy of looseness in organization. The scheme of organization should be clear and well defined, but the operation of it should be sane and reasonable and co-operative in its feeling.

The relation between the engineering departments—speaking broadly and including both the constructive and the operating engineering—and the commercial or business getting departments should be as close as possible, even to bringing them, if necessary, under one head, for their work when considered at their foundations is so dependent one on the other.

The plant and system to obtain the lowest costs of production must be efficiently and economically designed and constructed and the territory covered must be such as to produce sufficient income to bring an adequate return on the investment. This is the province of the engineer, but there is a fallacy in the statement unless we agree on what is an engineer.

The engineer, to fill that specification, must be of the highest, broadest type. He must have other qualifications than the ability to design the power house and calculate the sizes of the conducting wires and cables of the distribution system. He must have broad, sound judgment to determine the income value of any investment, of any extension or of any territory to be supplied. You may say at once this is not for the engineer to decide, but for the manager, or contract agent, or other commercial man, call him by any title you may choose. If we admit this, then we must acknowledge that there should be the most intimate relation between the engineering and commercial departments, and each should be thoroughly acquainted with the work of the other insofar as the return on the capital investment of the corporation is concerned. Unless this be so we may find a condition where the two departments are working at cross purposes, or, perhaps, through lack of proper knowledge, "saving at the spigot and wasting at the bunghole"; the operating department struggling to bring down costs of production by scaling down a few tenths of cents per kilowatt hour while the commercial department is being out-traded in whole cents per kilowatt hour by the clever engineer of the purchaser or perhaps by the unscrupulous bluffer who takes advantage of the weakness of the contract agent who does not know the value of the product he is trying to sell.

The engineer spends the money. The commercial man makes it. It takes brains to do either well. As the engineer must economically and efficiently design and construct the plant and system, so, likewise, must the commercial man economically and efficiently sell the product of the engineer. To do this it is desirable that the head of the contract department should be a technically trained man, either by education or experience.

If the contract agent, or manager of the business getting department, be a man trained as an engineer, either by education or practical experience, he is better able to handle the problems that confront him. Such training develops the analytical mind, increases the reasoning power, promotes sound judgment and teaches the man to differentiate between right and wrong. The man so trained does not do things by rule of thumb; he knows because he knows and acts upon his own knowledge, and does not follow blindly the lead given by others who may perhaps be mistaken in their conclusions.

Such a man is not dependent upon others in his negotiations with the shrewd and clever business man, who perhaps is an experienced man of affairs and generally acquainted with some of the fundamentals of rate making; nor does he have to call for assistance when dealing with the consulting engineer or architect employed by the owner or purchaser with whom he is trying to do business. His knowledge that he is perfectly able to discuss intelligently with his customer the problem at hand in all its phases will give him a distinct advantage over the untrained man and will inspire in himself confidence in his own proposition and furnish the necessary courage to meet any argument or objection advanced by the purchaser.

This courage, shown by the commercial man, will command the respect of the purchaser, and this when once established makes the negotiation easier. The courage becomes persuasion and makes its impression upon the purchaser, resulting in the contract being closed satisfactorily, whereas it might be lost entirely if the purchaser do not feel the confidence in the seller.

We all like to do business with the man who knows his business. The representative of the commercial department engaged in the sale of electricity in large quantities needs all the experience in engineering he can possibly command in order to cope successfully with the arguments advanced by the purchaser as to the cost of production. In many cases the question of steam for manufacturing, heating and other purposes enters into the problem, and it is essential that the commercial representative of the central station company be generally familiar with the cost of operation of apparatus using steam, so that he may be able to demonstrate the economy of central station service notwithstanding these costs.

He should also understand the fundamental underlying cost of production and be familiar with the influence of load factor upon the cost of production in an isolated plant as well as in the central station and be familiar with the load factors of various classes of business. He can only have this knowledge by experience and familiarity with different types of apparatus. He should be familiar in every way with the cost of operating a private plant, from the coal bin to the lamp or motor, being able to point out, if necessary, defects in the calculated costs made by either the architect or engineer. A man of this character should also be familiar with the operating costs of the central station, having at his fingers' ends the costs in detail and the methods of obtaining these costs. He can only do this by being familiar with the detail of construction and keeping in touch with the extension of the company's plants and systems. In this way he will know the difference between the cost of delivering the power from a central station system or from a private plant.

Since it is true that the cost of making electricity depends largely upon the load factor of the central station, the commercial man should know what effect a given piece of business would have on the general cost of producing electricity in the central-station plant, and whether making the contract for a large amount of power would have a tendency to reduce the cost of the whole power generated.

In making up a system of rates for large business it is necessary to have these rates made in such a way that they will bear a relation to the cost of production of electricity at different load factors. In this way only can the scale of rates be justified under the law, and unless the representative be familiar with how to determine the cost of electricity under differing conditions of load factor and quantity he would be unable to discuss intelligently the selling price of electricity in large quantities.

In urging the value of technical training for the contract agent or manager for an electric lighting or power business it is not meant that he should necessarily be an expert in higher mathematics or theoretical electricity; but he should understand the fundamentals of engineering. The volume and variety of business that will be obtained by the central station company will depend largely upon whether the business getting depart-

ment is captained and made up of men with or without engineering training, either that which comes through a technical education or from practical experience in the draughting room and shop or in working through the various branches of the business. The salesman who does not understand the technique of his business is at once at a disadvantage, requiring the assistance of an engineer, which means a duplication of expense.

In selecting men for both the engineering and commercial departments they should be chosen from as wide a range of education and environment as possible; the engineers, for instance, being taken not from one local educational institution, but from different engineering schools and colleges, so as to obtain the value of diversified view points as developed by the various teaching staffs, thus preventing narrowness of view.

We have heard the argument advanced in isolated cases that technical education is not a good thing for a man and does not produce results, and that technical men do not rise to the head of large institutions. These statements are not borne out by the facts.

While the financial heads of the various industrial institutions may not be technically trained men in the ordinary acceptation of the term, yet the administrative and executive heads of the organization who are engaged in the daily management of the business and responsible for the economical manufacture and sale of the products of the corporation are being drawn more and more from among the technically trained men. Those who argue against the technical man in business must remember that the great industrial development of this country has come within the last 25 years and that in the early days of this development there were few technical men aside from civil engineers and architects.

Fifteen or twenty years ago the principal selling men even in our technical business were those whose qualification was in being a "good fellow," but those days have passed and it is now the man who has the goods and can demonstrate their value through his knowledge of the business that makes the sale.

The purchaser is better fitted to-day than he was 20 years ago, has more general knowledge on all subjects of a technical character, even to having expert technical assistance at his call, and the next 25 years will find the technically trained man the actual head of most industrial undertakings.

There is a tendency among some technically trained men, especially the younger set who have been out of college but a short time and whose minds have not sufficiently matured through wide contact with the world, to feel that they should not devote any of their time and thought and energy to the commercial side of the business in which they are engaged as engineers; that it is unprofessional so to do and beneath their dignity.

That this is a mistaken idea many of them realize in later years, when their success in life has not been as marked as some of their fellow men. They do not appreciate in time that all technically trained men cannot be great scientists and that there is a splendid field awaiting the use of their training if properly applied in the great market of commercial life. On the other hand some of the commercial men seem to think that it is beneath them or perhaps it is too arduous for them to attempt to acquire any engineering information, waiving it all aside as "a mere matter of detail." A little persistent effort on their part to acquire knowledge would very often greatly increase the value of their services to themselves and to the company.

Why are the lawyers who have achieved marked success in their profession sometimes chosen to conduct the affairs of large undertakings? They are technical men. They are business engineers; they have been trained in the theory of what is right and wrong in business. Few lawyers of active temperaments would consider it beneath their dignity to give up a lucrative practice for the presidency of a large corporation or a great business. The same limitations which apply to the engineer as to his capability for the conduct of a large business apply similarly to the lawyer. He must be broadly educated either originally in his college life or in after years through contact with men of broad ideas and of broad experience.

The financier is a technical man; the expert accountant is a technical man—each in his own sphere. Neither would make good managers for large undertakings if they knew nothing of the technique of the other branches of their business or had not the special ability to direct men of technical training, or were not good judges of other men's ability.

Not only should there be close relationship between the engineering and the business-getting departments, but also between them and the accounting department. The accountant must get his figures from the engineer and the accounting must be well done, that the engineer may obtain the proper data to enable him to draw correct conclusions.

Electricity in the New First National Bank, Boston.

In its recently completed new building at the corner of Federal and Franklin Streets, Boston, the First National Bank of that city has employed electricity to an extent unusual in the older banking houses. The new building is a four-story structure of attractive architectural appearance, and the extensive use of electric lighting in its main banking chamber, offices, departments and vaults was a necessity for the preservation of the harmonious decorative effects and the convenience and comfort desired by the organization and its customers. About 40 rooms are included in the building, and the lighting is mainly carried out by carefully arranged 16-cp incandescents, either in chandelier or in special bracketed fixtures. A few large Gem lamps are in use also.

Current is supplied to the bank by a three-wire service of the Boston Edison Company, which is brought into the sub-basement to a panel containing five Wright demand meters and three recording wattmeters for the separation of the various power and lighting services. From the Edison panel, the different circuits are led to a two-panel distributing switchboard of gray marble, also located in the sub-basement. This board carries three spare meters for use in case the plant should ever become an isolated installation, and at present the circuits leading to the different floors and departments are controlled from this board by nine lighting riser switches, one main fan-motor switch, and three elevator switches, one other being left as a spare.

An extensive mechanical heating and ventilating plant is in service in the building, the engineering work having been done by Messrs. French and Hubbard, of Boston. All the wiring is in iron conduit, and the arrangement is such as to permit the most flexible service. Motors are used in the bank for several purposes, including the operation of pumps, elevators, carrier systems and adding machines. For the general ventilation of the building air is drawn into a spray chamber located in the sub-basement, by a 7-ft. fan driven by a 10-hp, 220-volt, direct-current shunt Crocker-Wheeler motor. A Cutler-Hammer starting box is provided for this motor, with a speed range from 520 to 650 r.p.m. This motor also drives a small centrifugal pump which supplies water for washing the air admitted to the building, the air being changed 10 times per hour. Steam coils are provided to enable the air to be warmed to the proper degree. An air pump is installed in this bank to provide the pressure required in the operation of the Johnson system of temperature regulation connected with the heating and ventilating apparatus. This pump is driven by a 5-hp, compound-wound Westinghouse 220-volt motor whose normal speed is 800 r.p.m., the connection between the motor and pump being a single shaft. This pump also supplies the necessary air pressure to deliver the drainage of the sump in the sub-basement of the plant to the sewer, which is at a higher level.

There are two passenger elevators in the building and one freight elevator or money lift. All are Otis machines driven by direct-current motors, and the control of each elevator is automatic, without the necessity of an operator. The push-button system is used to stop the cars at the proper floors.

The money lift serves the tellers and the vaults, principally, and runs to the second floor only.

The different departments of the bank are served by the pneumatic single-tube system, there being seven motors for the operation of this apparatus. These motors are all rated at ¼ horse-power each. The bank is also provided with an exhaust fan 4 ft. 6 in. in diameter, which throws the air from the more confined portions of the building to the roof. In the check teller's department are located 22 Burroughs electric adding machines, each motor being rated at 0.1 horse-power, 110 volts, 1225 r.p.m. An 18-station watchman's electric clock system is in service throughout the bank and the Gray telautograph is also in use. The bank is provided with the American District Telegraph service, also. We are indebted to Mr. Hall, superintendent of the building, for the foregoing particulars of the electrical installation.

CURRENT NEWS AND NOTES.

MUNICIPAL LIGHTING RATES IN OHIO.—Mr. D. L. Gaskill, secretary of the Ohio Electric Light Association, Greenville, Ohio, has compiled for the use of the members of the association a schedule of lighting rates of the municipal plants of Ohio.

NEW YORK PUBLIC SERVICE COMMISSION LAW.—The New York Assembly committee on electricity, water and gas supply has reported to the Assembly the bill amending the Public Service Commission law of last year by striking from the bill all limitations of the powers granted to the commission and giving jurisdiction over telephone, telegraph, ferry and stage companies, as recommended by the Governor. The bill in its present form is merely intended to clear the defects found in the law of last year.

INDUSTRIAL TRAINING SCHOOL GRADUATION AT BOSTON.—Fifty students of the Lowell Institute for Industrial Foremen, under the auspices of the Massachusetts Institue of Technology, received diplomas on the evening of May 27. Twenty-one of these were graduated from the electrical courses. Addresses were made by Director Parks, of the school; Acting-President Arthur A. Noyes, of the Institute of Technology; Prof. Elihu Thomson, of the General Electric Company, and Mr. A. Lawrence Lowell, trustee of the Lowell Institute. At the conclusion of the exercises the engineering laboratories of the institute were inspected.

COMMENCEMENT AT WORCESTER POLYTECHNIC.—Commencement week at the Worcester Polytechnic Institute will begin on Sunday, June 7, when the baccalaureate sermon will be preached at Central Church, Worcester, by the Rev. Shepard Knapp. On June 9, at 8 p. m., Prof. George I. Rockwood will deliver the annual engineering lecture, his subject being the "Steam Turbine." The hydraulic laboratory will be open for inspection at Chaffin's on June 10, and on commencement day, June 11, the principal speaker at the graduating exercises will be the Hon. James Logan, Mayor of Worcester, his subject being "Changing Industrial Conditions."

HARRIMAN TO ELECTRIFY SOUTHERN PACIFIC.—Mr. E. H. Harriman has sanctioned the work of converting the Southern Pacific Railroad from Los Angeles to Santa Monica into a double-track electric line as part of the Harriman Los Angeles-Pacific trolley system. Preliminary work has already been begun on this important undertaking and operations will be pushed forward rapidly. What is known as Long Wharf at Port Los Angeles, which extends for more than a mile from the shore, is to be used for both traffic and pleasure. A dancing pavilion will be built at the further end of the pier. This wharf, costing more than $1,000,000, was a hobby of the late Collis P. Huntington, but never was of great advantage to the Southern Pacific. The proposed change will open an extensive section to trolley traffic, but at the same time is an invasion of the so-called Huntington territory. The Los Angeles-Pacific has recently expended $1,250,000 for fine cars, many of which will go on the newly-changed line.

NEW HAVEN TROLLEY SUIT.—Counsel for the New York, New Haven & Hartford Railroad have received from the United States attorney-general the form of the decree which the attorney-general will request from the courts compelling the New Haven to dispose of its Massachusetts trolley holdings. The decree has been framed with a view to conforming to the Supreme Court ruling against the legality of such trolley holdings, and the time for its filing in court depends on the railroad counsel's opinion as to whether it so conforms. If they decide that it does not conform and they are unable to reach an agreement with the attorney-general, the matter in dispute will be argued before the court.

MASSACHUSETTS LIGHTING LEGISLATION.—Acting-Governor Draper, of Massachusetts, recently signed a bill authorizing the purchase, sale and consolidation of Massachusetts gas and electric companies. Under the provisions of the bill any gas company may consolidate with any other gas company doing business in a contiguous municipality, and any electric company may consolidate with any other electric company under similar conditions, but the bill exempts from the provisions of the act the consolidation of the Boston Consolidated Gas Company and the Edison Electric Illuminating Company, of Boston. Acting-Governor Draper has also signed a bill removing the limitation of capital stock, which may be issued by gas and electric light companies. The present limit of the capital stock which may be issued is $1,000,000.

AN UNIQUE RAILWAY COMPANY.—The Winona (Minn.) Interurban Railway Company is, as far as known, the only traction line which does not operate its cars on Sunday, and the only railway in the world whose receipts are used for the education of poor boys. The profits of the road go to the support of the Agricultural School, of Winona, and the Winona Technical School, at Indianapolis, which is graduating a class of practical electricians this year. It is said to be the only road in the world that has no watered stock, while its officers, with the exception of two, serve without pay. The cost of the road when completed will amount to $2,100,000, with a capital stock of $6,000. The bonded debt of the road is from $21,000 to $26,000 per mile. Its roadbed and equipment are excellent, and its management has been complimented by the Indiana Railroad Commission. Notwithstanding that no wheels turn on Sunday, the business done on this system is equal to any other system in the state in proportion to its mileage. The officers of the road are: H. J. Heitz, of Pittsburg, Pa., president; J. F. Byer, vice-president; Rev. S. C. Dickey, general manager, and H. S. Dickey, general superintendent.

HOW IT STRIKES ONE NOVELIST.—Some great novelists seem to like New York life and lighting. The well-known novelist, Amélie Rives, shares the dislike of some authors for prolonged residence in New York. There is a hostile description of Broadway at night in her latest novel, "The Golden Rose," as follows: "The sheets of lilac-tinted light that poured from every side showed her faces avid for pleasure, tense with the greed for the sensations that are purchasable; set, whether smiling or rest, in a predetermined resolution of enjoyment, that turned the tinsel night into an artificial day of labor. She felt that if the Statue of Liberty in the harbor were to call aloud in some great cause, it would be with a fierce, megaphonic shout in which all these street clangors would be blended. She sat silent and dismayed, watching the red glare of the huge advertisement that glowed like its crown jewel on the forehead of this distorted harlot night of Broadway. And she thought of the quiet, snow-wrapped fields of Kingsweather, and of the leafless branches of the trees before her window, quivering with a thousand stars, as in the soft June nights they quivered with the delicate fireflies."

Lighting of the Hotel Albany and the College Inn, New York City.

BY H. THURSTON OWENS.

ONE of the hostleries which New York provides for those whose inclinations are toward late hours and gayety is the Hotel Albany with its café, "The College Inn," at the southeast corner of Broadway and Forty-first Street, shown in Fig. 1. The hotel was well known as the Vendome

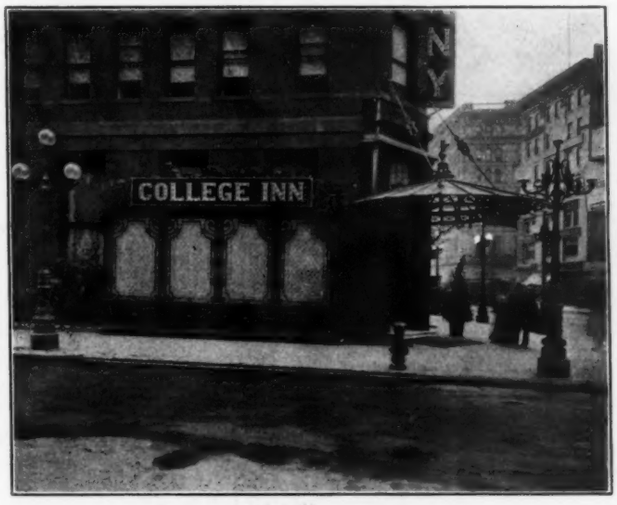


FIG. 1.—ENTRANCE TO COLLEGE INN.

long before Broadway acquired its title of "The Great White Way" and the building has recently been remodeled at an expense amounting to nearly $400,000. The exterior has all of the embellishments of an up-to-date hotel, namely, the roof is outlined with lamps and there are five illuminated signs, 10 lamp-posts, and a marquee at each entrance. As New York hotels go, its height is not great, being only nine stories, but the building is higher than its immediate neighbors, so that the roof signs can be seen some distance away.

Each sign contains 220 8-cp lamps, and, in addition, one of

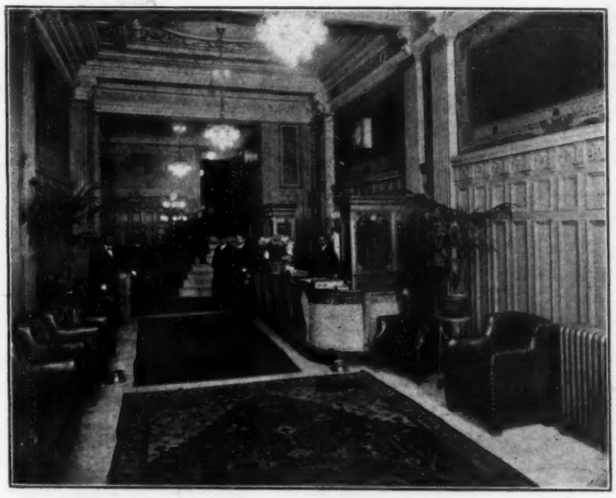


FIG. 2.—REAR END OF LOBBY.

the signs has a crest with red color lamps. The vertical building sign reads "Hotel Albany" on each side and is equipped with 2-cp lamps, 278 to the side.

There is a much smaller sign reading "The College Inn" over the entrance to the restaurant, in which there are only 48 2-cp lamps. The lamp-posts along the curb may not be considered aesthetic, but they serve their purpose as spectacular sentinels of welcome. Each is equipped with three frosted globes, enclosing one 50-cp lamp. The roof is outlined by 336 4-cp lamps arranged along the edge. Although a comparatively small hotel, the amount of exterior illumination provided is only exceeded by one other hotel in the metropolis.

The lobby is an interior room with an entrance on Broadway, and parallels the bar, which occupies the corner. The room is rather long, but, nevertheless, has a comfortable atmosphere, due entirely to the skill with which the decorations and illumination have been carried out. The rear end is shown in Fig. 2.

A dark-colored wainscoting covers over half of the walls, the remainder being tinted a cheerful red. The ceiling is paneled, and from the center of each panel hangs a chandelier. These are equipped with 13 16-cp round, frosted lamps; pendant and near the ceiling are 4 25-cp lamps of similar pattern. The carpet is red and the large, comfortable chairs which line the walls are of red leather; numerous palms complete the decorations.

The barroom is one of the most spacious and best appointed in New York. It has several features which would call for comment even if they were found in five and ten million dollar hostelries. The bar covers over half of one side of the room and behind it is a wonderful example of the glass-maker's art —an immense mirror in three sections. On the opposite side of the room, between each of the windows, are two pilasters of

FIG. 3.—CRYSTAL CHANDELIER IN BARROOM.

green marble with capitals of gold. At the front end forming the entrance is a cupola in art glass, and at the rear an oil painting. The ceiling is beamed and in bright colors, thereby increasing the apparent height of the room. In the center hang two beautiful Louis Quinze crystal chandeliers and on the walls are brackets in the form of torches, as shown in Figs. 3 and 4. The brackets hold 5 50-cp clear tantalum lamps. In addition to

these there are four ornamental fixtures behind the bar, two being bronze figures, each holding a torch in each hand, and the other two being miniature standards in a niche at each end of the bar.

The ladies' reception room, shown in Fig. 5, is arranged as a foyer at the ladies' entrance on the Forty-first Street side. The decorations in both color and design are similar to those in the lobby. The illumination is furnished by means of pendant frosted balls, and in addition there are art-glass lamps upon the writing tables. In the newels at the foot of the interior stairway are bronze fixtures in the form of cats'-tails, tubular frosted lamps forming the blossoms. The men's writing room is adjacent to the ladies' reception room, and brackets with frosted enclosed globes furnish the illumination.

FIG. 4.—BRACKET IN BARROOM.

The dining room completes the list of public rooms upon this floor. It has a low ceiling with large pillars down the center of the room. These are painted white, as is the ceiling, the walls being tinted a soft green. There are crystal ceiling lamps in each panel, and bracket lamps on the pillars and the walls. Table portables with pink silk shades add the necessary touch of cheerfulness.

FIG. 5.—LADIES' RECEPTION ROOM.

In the basement is found the College Inn, which occupies almost the entire floor; practically all of the light being artificial. The room is finished in Flemish oak with paneled ceiling of dark brown, the walls being half wainscoted, the upper portion being decorated with original paintings. The only decorations aside from the paintings are the college flags and, as will be seen from the illustration Fig. 6, these are very much in evidence.

FIG. 6.—GENERAL VIEW OF COLLEGE INN.

In this room the lamps, in the ceiling sunbursts, each of which contains 5 16-cp round, frosted lamps, are in an almost horizontal position. See Fig. 7. Another feature is the lighting of the wall paintings. The top of the wainscoting contains a sheet of thin roughed glass beneath which, at each painting, is

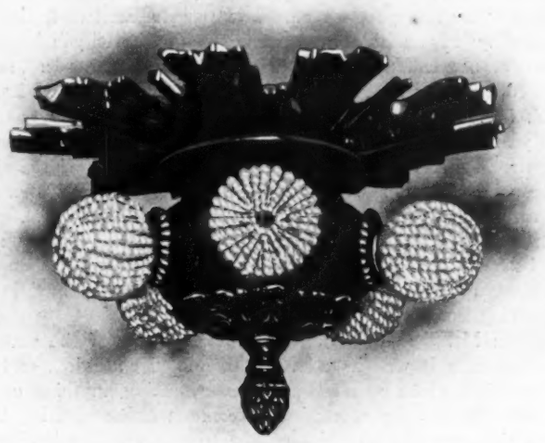


FIG. 7.—CEILING SUNBURST IN COLLEGE INN.

placed two 16-cp tubular lamps. The lamps are tinted red, blue or green, the color of the painting determining which one is to be used. Nearly 300 lamps are used for this purpose and they add greatly to the pleasing effect. The coefficient of reflection is probably less than 0.20 and the intrinsic brilliancy of the lamps not over 5 cp per square inch. There is no glare whatever and the general illumination is excellent. The decorations probably represent a large percentage of the college spirit, but gayety is much in evidence. The success of the hotel is due in a large measure to the success of the Inn.

The guest-rooms have chandeliers with opal shades, 16-cp clear-bulb lamps being used. The service portions are equipped with clear-bulb 16-cp lamp clusters with white porcelain reflectors. The only glaring lights are to be found in the bar-room, but that is a fault common to all such rooms in the East. The general public forms its opinion of a hotel from its public rooms, and those in this hotel are very successful in one respect—they breathe the spirit of the place as being informal.

Electric Power Development on the Rio Grande Border.

By W. D. Hornaday.

The first electric railway to be built in Texas and one of the first in the United States was at Laredo. The building of this line in 1889 by the Laredo Improvement Company attracted wide attention, as the use of electricity as a means of rapid transit was at that time just emerging from its experimental stage. The promoters of the Laredo project believed that the town was destined to become a great commercial and manufacturing center, and for a few years it enjoyed a wonderful growth and activity. Shortly after the building of the railway a long period of business depression occurred and it passed through many trying vicissitudes, and the plant was finally taken over by the Laredo Electric & Railway Company. The holdings of this company include the electric lighting system as well as the street railway. The lighting system is unique in the fact that it does an international business, the plant providing lights for the city of Neuvo Laredo, situated on the Mexico side of the Rio Grande.

The business of the Laredo Electric & Railway Company possesses many features of interest. The railway and lighting plant has been completely overhauled and modernized during the last three years and the business extended to an exceptionable degree under the direction of the manager, Mr. Frank E. Scovill. At the time he took charge of the plant in December, 1904, the cars were being run with little attempt to observe a regular schedule and the lighting service was very unsatisfactory. The plant at that time consisted of two 60-kw single-phase machines and a small direct-connected, 64-ampere, 500-volt machine for operating the street cars over the 5¼ miles of railway. The circuits at that time were fairly well loaded. The engines were old, and one of Mr. Scovill's first acts was to purchase two second-hand tandem-compound condensing engines that had been used 14 years, and a couple of three-phase 150-kw generators. The circuits were changed from single-phase, 125-cycles, to three-phase, 60-cycles, and the installation of small motors for power purposes commenced, afterward increasing to larger size motors until the company now has in operation 233 horse-power in power motors, ranging from 2-hp to 40-hp capacity, besides a large number of ¼-hp and ½-hp motors on coffee mills and such small work. When the circuits were changed to 60-cycles there were 26 fans in service. The number of fans has now been increased to more than 200.

The lighting and power business has increased so rapidly that the company has just purchased and finished the installation of a 2300-volt, three-phase generator direct-connected to a Hamilton-Corliss cross-compound engine of 550-hp capacity.

The valley of the Rio Grande adjacent to Laredo has become during the last few years one of the greatest Bermuda onion producing regions in the world. This year's crop, the harvest of which was begun the first part of April, embraces 1500 acres. All of this land must be irrigated, and the only source of water supply is the Rio Grande. This acreage is almost double what it was the preceding year, and next year the acreage will show a still greater increase, it is claimed. It occurred to Mr. Scovill that here was an opportunity for his power plant to render a good service and at the same time add materially to its revenue. Gasoline and coal were the fuel that was being used by the numerous irrigating pumping plants scattered along the river front. The substitution of electricity for this fuel was urged by Mr. Scovill and he finally awakened an interest in the proposition. He personally guaranteed the success of the first pumping plant he sold last August. It was installed in time for the watering of the onion seed beds,

MOTOR-DRIVEN PUMPING STATION.

which work was begun the latter part of September. The installation consisted of a 40-hp, 2300-volt motor, direct-connected to a Janesville No. 8 pump, which was set in a well 36 ft. deep, 12 ft. across, built of concrete, and located upon the bank of the river. The pump was guaranteed to life 1400 gal. of

water a minute at a total elevation of 75 ft. through 600 ft. of 12-in. pipe. This electric pumping plant has been in operation constantly ever since its installation and attracted much attention among the onion-growers. Two more electric pumping outfits were soon sold and installed and were in successful operation during the onion-growing season. The company received several other applications for these outfits during the fall and winter, but could not get deliveries in time to care for the season's crop of onions. The onions in the Laredo territory are transplanted from the seed beds from Nov. 20 to Jan. 1, and are harvested from about April 1 to May 10.

The first 40-hp line for operating these irrigating pumps was built close to town. The other two pumping stations being farther away, a line had to be built more than four miles from the edge of the lighting district into North Laredo. At present the service for operating these pumps is being furnished from the regular lighting circuits, but the calls for additional motors are so numerous that it will be necessary to build a new transmission line direct from the power plant across the country to North Laredo in order to meet the demand for additional installations. In building this line a step-up transformer will be used at the plant, stepping down again to 2300 volts about the center of the pumping district in order to increase the capacity of the circuits. The company has assurance of enough additional pumping plants to justify this proposed enlargement, and it will be completed same time during the coming summer in time for next season's crop.

In addition to this proposed transmission line to be built to the onion-growing district of North Laredo, another line will be built to South Laredo to operate the pumps of the growers of that section. The South Laredo district onion growers are now securing right of way across the different tracts of land, called porciones, to allow the company to extend its line to them to operate six pumping plants, which will be installed immediately. One of these plants will be of 30-hp capacity motor, three will be of 40-hp and two of 60-hp.

The embarking into the electrical pumping business gives the Laredo plant a day load for nine months of the year in excess of the night load. Mr. Scovill is a believer in the three-phase method of power distribution. He installed the first three-phase machine in Texas in 1895 at Austin. At the time of the break in the dam across the Colorado River at that place, this machine fell with the power house and was covered under 7 ft. of sand for some weeks. It was then taken out, washed off with a hose, taken apart and the sand removed, dried out and used as a motor to drive a Worthington pump at the water works at Austin for some time, afterward being replaced by a larger motor. The same machine is now doing service in the Austin electric-light plant.

In connection with the irrigating pumping plants in the Laredo district, the Laredo Electric & Railway Company made a rate of 5 cents per kw-hour. The cost to the consumer for operating the pumps, being a little less than 4 cents per hp-hour, is said to be much better for the average onion grower than the use of steam or gasoline for pumping purposes, as the electric pumps do not require the service of an expert or constant attention. During the past season one of these 30-hp pumps, operated by electricity, has irrigated 110 acres of onions at a total cost to the consumer of less than $9 per acre for the entire winter's irrigation. When the fact is considered that no rain has fallen in the Laredo section for more than eight months and that the dry soil naturally requires a great amount of water, this record of cost is surprisingly small. As compared with the revenue per acre derived from the crop it is insignificant. The gross receipts per acre from the sale of the crop ranges from $400 to $800.

It is stated that some of the steam-pumping plants have done a little better than the electric plants in the matter of cost, but in figuring their cost the amount that must be expended each year in repairs to their boilers and plants is not included. When these incidental expenses are added, the cost will be found greater than that of the electric pumping stations, it is said. Many of the onion growers claim that the freedom from the worry and expense of operation and making repairs which the electric pumping stations afford them is worth much more to them than whatever slight difference there may be in the cost per hp-hour of their operation.

There are prospects of a good business being built up on the Mexican side of the river in operating irrigating plants with electricity. Onion growing has just been started on that side of the Rio Grande, about 100 acres of the product being raised there this past season. The Laredo Electric & Railway Company has a lighting contract with the city of Nuevo Laredo, Mexico, as well as with Laredo, Texas. In Mexico the concession is held by one of the citizens of Neuvo Laredo and, in turn, the company leased this concession for a term of years. The company furnishes the same 24-hour service on the Mexican as it does on the American side of the river. The principal article of food of the working class of Mexicans is tortillas, which are made of soft ground corn meal. The introduction of electric power for operating the tortilla mills in both of the border towns has displaced gasoline engines in these mills and the company is doing a good business in supplying energy for these motors.

When Mr. Scovill assumed the management of the plant of the company it was in a badly dilapidated condition, and the owners had given up all hope of ever making anything out of it. But the development of the Bermuda onion growing business, the general prosperity of the town and the adoption of modern methods of operating the enterprise, put new life into the concern. It is expected that the present capacity of the plant, which is 1050 horse-power, will have to be nearly doubled within another year in order to meet the demands that are being made upon it for additional power.

The company's lighting and power rates are said to be as low as any in Texas. The city of Laredo has a population of about 3500 Americans and 14,000 Mexicans. It is growing rapidly under the new industrial influences that have been awakened there by the success of onion growing. It is estimated that this year's onion crop will bring to that immediate locality more than $1,000,000 in cash. Much of this enormous revenue will be expended in making improvements with a view to enlarging the industry.

The Public Service Corporation and the Public.

By H. H. MacPherson.

Every business man knows that the expenditure of a given sum of money in pushing his business will bring in much larger net returns from an old customer than from a new one. The practical application of this fact is the most striking characteristic of the present new-business movement by the gas and electric companies. This is unusually noticeable at this time because of the high interest rates prevailing and the consequent unwillingness of managers to use this high-priced money in making extensions. The very latest development along this line is the employing of so-called service supervisors. There is one of these men to every two representatives and working on nothing but old consumers and discontinued services. The better the quality of the service rendered by the company, and the more satisfied the consumer, the greater the net return from this work.

In order to improve the service and satisfy the complaints of consumers each gas or electric company maintains a complaint or investigation department. So far, the scope of this work has been limited to receiving complaints and settling each case upon its merits. The causes of these complaints are not removed, and thus they increase the complaint department expenses.

In the gas and electric business the inherent faults of the large corporation are peculiarly liable to cause trouble. For example the absence of any personal touch often sends a consumer from department to department in an effort to obtain a desired result. This division of authority is hopelessly confusing to the

consumer, and an error or two will quickly put him into the class of dissatisfied consumers.

That this condition of affairs is unnecessary and that the remedy is inexpensive and thoroughly practical may be learned from the following lesson from the complaint department.

The object of the complaint or investigation work as conducted by all gas and electric companies is to obtain and keep the good will of the public by receiving complaints and settling them justly. It is universally acknowledged that this work pays large dividends in satisfied consumers. Then it should follow that preventing complaints will pay even better. These complaints and the causes leading to them when properly recorded and analyzed form an immensely valuable fund of information regarding the real opinion of the company held by the public and the causes for holding that opinion.

A surprisingly large percentage of these complaints can be prevented, and at a very small cost, by ascertaining and removing the cause. Each source of weakness thus removed lays bare the cause of some other trouble, and so almost automatically the good work goes on, building up the organization internally and the good will of the public externally; the kind of good will that pays large dividends because the complaints are eliminated by the ounce of prevention, worth in this case many times the pound of cure. The high-bill complaints, the smallest in point of numbers, are highest in the total expense. Their number is lowest in summer and rises to a maximum with the long lighting hours of December. This seasonal variation will exist regardless of the total number of these complaints. There will always be a chronic kicker, and some few people who need to have their imagination talked away into a negligible quantity. But outside of these few it is the great body of honest people who have to feel a real grievance to get them started. A high-bill complaint from one of these people means that he has either lost confidence in the honesty of the company or in the correct reading or registration of his meter. Whether the company is honest, or his meter correct, matters little. His natural suspicion of a public service corporation has been turned to a certainty, otherwise he would not have made a complaint.

That this is true has been conclusively proved by the author by means of a system of records which show numerous cases of people, who previously paid cheerfully, now complaining, through some error on the part of the company. Granting rebates, changing and testing meters, do not mean justice to them, but simply indicates that the company has been "caught in the act" and is trying to get out of it.

A thorough realization of this fact and a determination to keep non-complaining consumers from becoming chronic kickers by removing causes tending to make them become so, is the ambition of the far-sighted manager.

Three-fourths of the high-bill troubles can be traced directly to variations in the amount of the bill caused by over-reading or under-reading of meters, skipping readings or bills for a greater or less period of time than 30 days.

Over-reading and under-reading of meters are the fault of the meter readers, but the bookkeepers are qually to be blamed if these show on the bills, because they can see at once any great variation in the bill provided the number of days between readings is kept always the same. The fact that some meter readers make no errors for nine consecutive months proves that incorrect readings can be prevented. Incorrect readings are nearly always for 1000, 10,000 or 100,000 cu. ft. of gas, or for 10, 100 or 1000 kw-hours of energy. The meter reader is just as liable to read the higher dials wrong as the lower ones, but the bookkeeper will have less trouble in catching the large errors. Therefore, here again it is the small errors that get out on the bill and cause the trouble.

Over-reading usually results in an immediate complaint; a new reading and a corrected bill will satisfy the consumer temporarily. His confidence has, however, been undermined. His next high-bill complaint may result in a new reading which shows the bill to be correct and then he believes that the meter is wrong. The change and test of the meter, even if correct, does not change his opinion; it is too late for anything to change it.

An under-reading produces the same result as an over-reading, but no corrected bill or rebate can be made because the consumer has already received payment of the smaller amount.

When a reading is skipped from any cause whatsoever every effort should be made to obtain a reading as soon as possible. In case the meter reader is unable to reach the meter, an appointment can usually be made for a certain day each month, or the key can be left in an accessible place. The bookkeeper should also see to it that none of his requests for re-reading is ignored. If they are, the bill will not go out at its regular time.

Most of the bills for a greater or less period of time than 30 days are in the main caused by skipped readings, changes in meters, investigations or bookkeeping errors, or by having the reading dates separated by more or less than 30 days on account of carelessness. Bills held on account of changes in meters are especially liable to start trouble, particularly when the meter taken out runs too slowly. The consumer not only has a two-months' bill to pay, but his rate of consumption is largely increased. Of course, he believes that the company has removed a correct meter and substituted a fast one. If before the change is made he is told that it is being done for the sole purpose of keeping all meters in first-class condition, and that in the absence of a reading his will be held, there will be very few complaints from this source.

The element of carelessness on the part of the company appears somewhere, in some form, in every high-bill complaint. The average meter man does not worry if he does over-read or under-read a few meters each month. Neither does the bookkeeping department care whether a bill is for 30 days and $1 or for 50 days and $100.

If these two departments thoroughly understood that just such little things cause three-fourths of all the high-bills complaint, and that this class of complaints in some cases cost a company directly $10,000 per year and upward, they could easily reduce them to a negligible quantity.

Direct-Current Motors, Their Action and Control—VIII.

By F. B. Crocker and M. Arendt.

MOTOR CONTROL BY MULTIPLE VOLTAGE.

Ward Leonard System.

The first of these, historically, is that of H. Ward Leonard,* who employed three generators of 62, 125 and 250 volts, respectively, and grouped them in series in the order named (Fig. 1). Connecting the field across the 250-volt lines, and

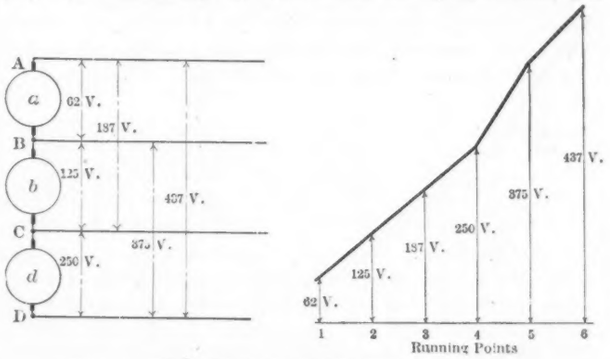


FIG. 1.—WARD LEONARD MULTIPLE-VOLTAGE SYSTEM.

the armature terminals across *A-B*, 62 volts would be obtained, across *B-C* 125 volts, across *A-C* 167 volts, across *C-D* 250 volts, across *B-D* 375 volts, and across *A-D* 437 volts; or, taking the speed at the highest voltage as the normal value, the various running points would give speeds of approximately

*U. S. Patent No. 478,344, July, 1892.

1/7, 2/7, 3/7, 4/7, 6/7 and 7/7, a sudden jump in the voltage increment occurring at the fifth point. The 5/7 speed value, or that corresponding to 312 volts, could not be obtained, because to get this voltage *A-B* would have to be added to voltage *C-D*, which would short-circuit the voltage *B-C*.

Crocker-Wheeler System.

The next four-wire multi-voltage system developed was that of the Crocker-Wheeler Company, employing voltages of 40, 120 and 80 in the order given. (Fig. 2.) By connecting the field terminals across the 240-volt lines *AD* and shifting the

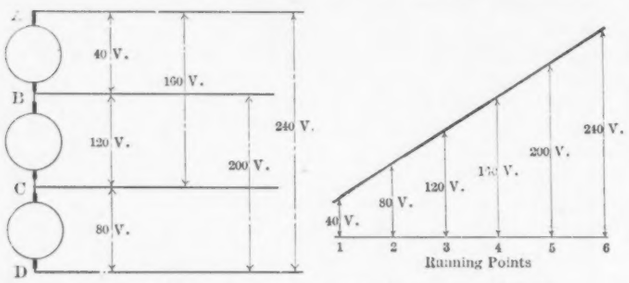


FIG. 2.—CROCKER-WHEELER MULTIPLE-VOLTAGE SYSTEM.

armature terminals from *AB* to *CD*, to *BC*, to *AC*, to *BD*, to *AD*, six voltages and speeds are obtained as follows:

AB gives.....	40 volts	*AC* gives.....	160 volts
CD "	80 "	*BD* "	200 "
BC "	120 "	*AD* "	240 "

These voltages correspond approximately to 1/6, 2/6, 3/6, 4/6, 5/6 and 6/6 of the rated speed. Thus, with this system, the speeds increase in a straight line, or in an *arithmetical progression*, there being no jumps, but a uniform rise throughout.

Any multiple voltage system may be worked at any reasonable maximum; they differ only in the ratio of voltages. It is desirable, however, to have *standard values for at least the maximum and one of the sub voltages*, in order that standard lamps, motors, etc., may also be supplied from the lines.

Bullock Multiple-Voltage System.

A third multiple-voltage method is that of the Bullock Company employing voltages which increase in *geometrical progression;* that is, the voltages are in the following ratio: a: ar: ar^2: ar^3: ar^4: ar^5. As these values must all be obtained in practice from a single system consisting of only four conductors it is necessary that $ar^3 = a + ar$, that $ar^4 = ar + ar^2$ and that $ar^5 = ar^2 + ar^3 = a + ar + ar^2$.

The only factor r which satisfies these conditions is 1.3247; that is, each voltage is 32½ per cent, or about one-third, higher than the preceding. The commercial system according to this plan employs 60, 80 and 110 volts in the order named. These are only approximately in the ratio stated, the theoretically correct values being 60, 79.5, 105.3. (Fig. 3.) The armature voltages and speeds obtained by connecting the armature terminals of the typical 10-hp motor to the various conductors are as follows:

Terminal Volts	$I_a R_a + D_b$	C. E. M. F.	Speed in R. P. M.
60	11.8	48.2	182
80	11.8	68.2	258
110	11.8	98.2	374
140	11.8	128.2	485
190	11.8	178.2	673
250	11.8	238.2	900

The Crocker-Wheeler method gives a speed range which is actually 1 to 8, while the Bullock arrangement gives a speed range of exactly 1 to 5, the total number of controller steps being the same for both.

The efficiency of these multi-voltage systems of control is much higher than that of the armature-rheostatic method for corresponding torque and speed changes. Let us consider the 10-hp motor, the data of which was given in the first issue of December, 1907, and determine its efficiency at rated torque and the various speeds obtained by, for instance, the Crocker-Wheeler multi-voltage system.

The first step is to determine the various speeds at rated torque corresponding to impressed voltages of 40, 80, 120, 160, 200 and 240, respectively, and from these to determine the motor output and efficiencies for the said 10-hp motor:

Voltage Input	Watts Input	$(I_a R_a + D_b)$	c.e.m.f.	$\frac{\text{r.p.m}_z}{\text{c.e.m.f}_z}$	Watt Output $\frac{7570 \times \text{r.p.m}_z}{825}$	Effic. at Rated Torque
40	1710	11.8	28.2	106.	971	56.6%
80	3190	11.8	68.2	258.	2370	74.2
120	4670	11.8	108.2	409.	3750	80.1
160	6150	11.8	148.2	560.	5150	83.5
200	7630	11.8	188.2	711.	6530	85.6
240	9110	11.8	228.2	862.	7920	86.7

Comparing the efficiency curve (Fig. 4) of the multi-voltage

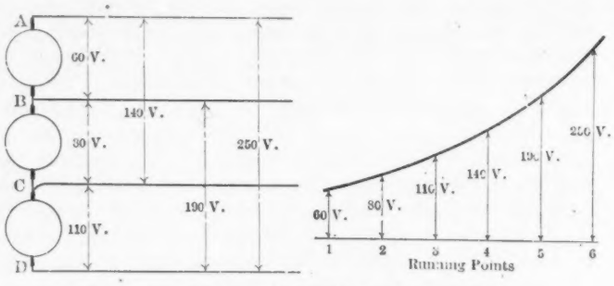


FIG. 3.—BULLOCK MULTIPLE-VOLTAGE SYSTEM.

method of speed control with that of the rheostatic method at rated torque, Fig. 1 (February), it is at once apparent how much higher the *average efficiency* of the former method is. An even greater advantage of this method over the rheostatic control is its *better speed regulation* under variable loads. The curves in Fig. 5 and values in the following table show this very clearly:

Speed Regulation, 10-hp Motor.

Multi-Voltage Control			Rheostatic Control Max. V = 240		
R. P. M. Rated Torque	R. P. M. No Load	Per Ct. Speed Change	R. P. M. Rated Torque	R. P. M. No Load	Per Ct. Speed Change
Curve A 106	145	13.7	Curve a 106	854	705
Curve B 258	296	11.5	Curve b 258	865	235
Curve C 409	447	9.2	Curve c 409	875	114
Curve D 560	599	7.0	Curve d 560	883	48.4
Curve E 711	750	5.2	Curve e 711	892	25.2
Curve F 862	910	4.6	Curve f 862	910	4.6

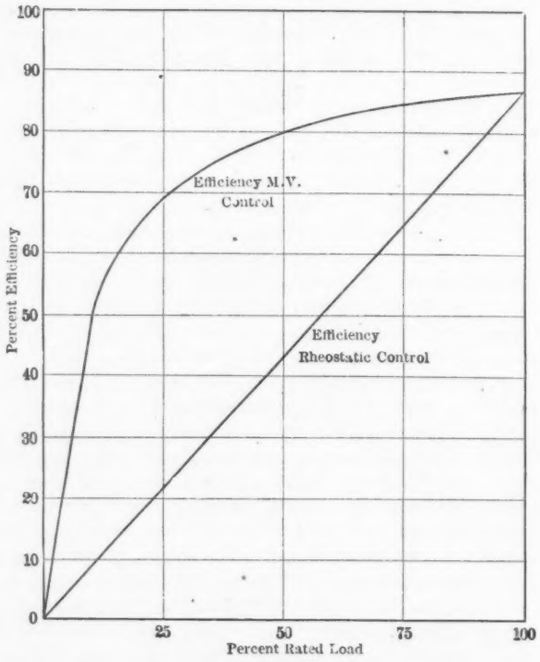


FIG. 4.—EFFICIENCIES OF RHEOSTATIC AND MULTIPLE-VOLTAGE SYSTEMS.

A comparison (by calculation) of efficiency between the field-control methods and the multi-voltage control is impossible, since the one starts at a *minimum speed* and *maximum efficiency*, and the other starts at a *maximum speed* and *maximum efficiency*. Furthermore, the first operates at a *constant*

output and the second at a *variable output;* hence the two methods call for different types of motors.

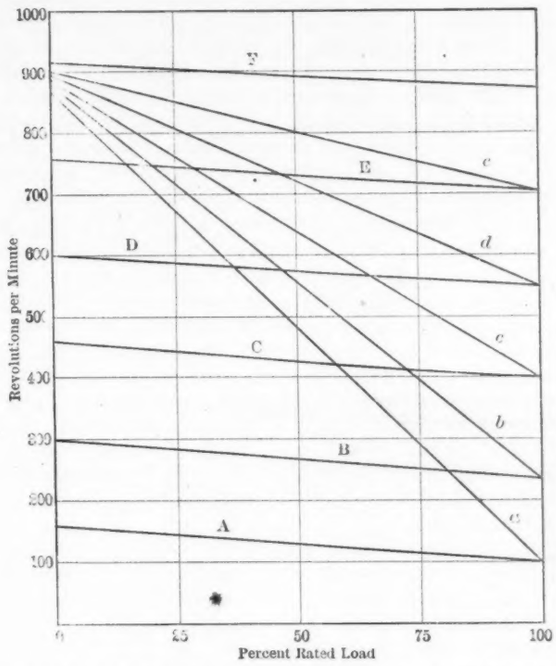


FIG. 5.—SPEED REGULATION OF RHEOSTATIC AND MULTIPLE-VOLTAGE SYSTEMS.

The multi-voltage systems can be supplied by three generators of, for instance, 40, 80, 120 volts, respectively, and each large enough to carry one-third of the total motor load, or by means of one generator of total voltage and load capacity,* and a three-unit balancing set (Fig. 6), each respectively of 40, 80 and 120 volts. These balancers, it has been found by experience, need have only a total capacity of from 5 to 10 per cent of the plant load. This latter method is the more frequently employed as it is cheaper in the following respects:

(a) Lower cost of prime movers, only one instead of either three engines or a system of line shafts, belts, etc.

(b) Lower cost of generator, a large one in place of three smaller ones.

(c) Lower cost of foundations.

(d) Less steam piping.

The motors on the multi-voltage system are ordinary standard machines, which is an important practical advantage. They are so connected that the field is permanently across the 240-volt lines and the six running speeds are obtained by shifting the armature terminals from sub-voltage to sub-voltage by means of the controller drum as shown in Fig. 7. In some cases the changes from one running speed to the next are made gradually by shifting to the next higher voltage with some resistance inserted in the armature circuit and then gradually reducing this resistance until that full sub-

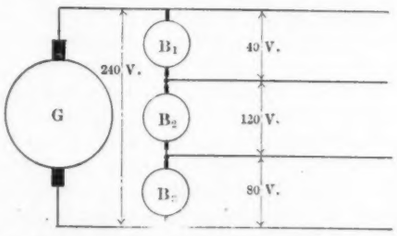


FIG. 6.—MULTIPLE-VOLTAGE SYSTEM WITH BALANCERS.

voltage is applied to the armature terminals and so on with the various sub-voltages until the maximum pressure is employed.

*Total load capacity is not necessary, as it is not likely that all tools will be operating at once at rated load; in fact, the maximum working load is not likely to reach 50 per cent of the possible load. Total load has been assumed for the sake of simple comparison.

In other instances a combination of variable field resistance and armature-rheostatic control is employed in passing from sub-

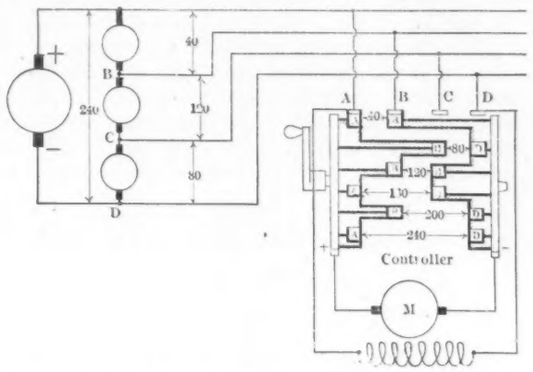


FIG. 7.—CONTROLLER AND MOTOR CONNECTIONS, MULTIPLE-VOLTAGE SYSTEM.

voltage to sub-voltage, thus obtaining sometimes as many as 36 speed points.

Footlights in a Chicago Church.

Those interested in providing good church illumination have doubtless met with the objection sometimes made by ministers and public speakers of having all light come from above, so that the eyebrows shade the eyes. In the Hyde Park Presbyterian Church in Chicago this has been overcome by placing a pair of footlights in each corner of the pulpit. These footlights are in boxes sunk level with the floor, each box containing a 32-cp lamp with a conical mirrored concentrating reflector pointed in the direction of the minister's face. There is thus one of these lamps on each side and a little in front of the minister. The footlight boxes are covered with diffusing glass so as to soften the glare.

Tungsten Cluster Maintenance in Chicago.

Mention has already been made of the flat-rate tungsten clusters being installed by the Commonwealth Edison Company in Chicago, these flat-rate clusters being turned on and off by the company's patrolmen. The rates on these clusters, which consist of four 60-watt tungsten lamps, are as follows:

Hours of burning.	Days per week.	Weekly charge, per fixture.
Dusk to 10 P. M.	6	
Dusk to 12 P. M.	1	$1.15
Dusk to 12 P. M.	7	1.50
Dusk to 1 A. M.	7	1.75

The company also has a proposition whereby it will maintain tungsten clusters connected to a meter. The number of hours' use per day of the clusters connected to meters is determined by the readings of a maximum-demand meter used in connection with all customers' watt-hour meters. For tungsten cluster installations used four hours or less per day, the fixed sum of $1.50 per month per cluster is charged to cover the cost of the fixture, lamp renewals and attendance. Customers sign an agreement that they will not touch the lamps, as the company does all cleaning and maintaining, and the lamps are fragile.

Tree Trimming.

At the Nebraska convention, one of the questions taken up in the question box was that of tree trimming. Mr. J. G. Boyd recalled an experience of his in Texas, where the City Council would not authorize the trimming of trees. One of the 2200-volt lines of the company burned off a tree limb. He pointed out that the city was liable for this damage because it did not permit trimming of the tree, after which it did not take the Council long to pass an ordinance permitting tree trimming. Mr. L. E. Watson, of Beatrice, Neb., expressed the opinion that by using proper diplomacy a central station could get per-

mission to trim almost any tree. Much of the trouble about tree trimming had resulted from careless slashing in the past or from not properly approaching the property owners. Mr. L. J. Schwengel, of Holdredge, Neb., in this connection, said that formerly the telephone company on some streets ran their wires above those of the electric light company, with the result that there was continual trouble from falling of telephone lines on the electric light wires. On recent joint pole construction, the telephone wires had been placed below the electric light wires, and there had been almost no trouble since then.

Electric Light and Power at New Bedford, Mass.

By William H. Stuart.

New Bedford, Mass., is a city that has grown from a whaling town of colonial days to a modern, up-to-date city of 83,000 inhabitants with a standing sixth among the cities of Massachusetts in population. When the new mills now building are completed and in operation, the population will be more than 90,000. The industries of New Bedford are the manufacturing of fine cotton goods and yarns, silverware, cordage, chairs, steel tools, engines, and machinery. New Bedford ranks first in the United States in the manufacture of fine cotton goods. The catch of oil and whalebone by vessels owned in New Bedford, an industry long the mainstay of the city, is gradually becoming a thing of the past. Its value in 1907 was $200,000, against $420,000 of the previous year.

In the year 1881 the New Bedford Electric Light Company was organized to light the streets of the city with an equipment consisting of a Thomson-Houston arc generator of 100-light capacity. Matters went along this way until year 1886 when the Edison Electric Light Company was formed to furnish light and power on a considerable scale, and built a plant in the center of the city. Fair progress was made in obtaining incandescent lighting, but no power load to speak of was taken on. In 1888 the New Bedford Gas Light Company purchased the franchise of the New Bedford Electric Light Company and started to produce and sell electric current in competition with the Edison Company. Two years later, in 1890, the New Bedford Gas Light Company and the Edison Electric Light Company consolidated and enlarged the Edison station in the center of the city to take care of all the business of both companies. Three years later, in 1893, a new station was built on the property of the gas company on Water Street. From 1892 to 1896 power was furnished the trolley company to operate its system, which was the first installed in New England.

The present equipment consists of two Dillon boilers of 175 hp each; three Roberts boilers, one of 150 hp and two of 125 hp each, and one Babcock & Wilcox boiler of 416 hp. The engines are five in number, and consist of one Green engine of cross-compound condensing 650 hp; one Harris-Corliss engine of cross-compound condensing, 350 hp; one Westinghouse cross-compound condensing of 300 hp; one Ide simple condensing of 250 hp, and one Armington & Sims simple of 50 hp. There is also a Curtis turbine of 450 hp. A 500-hp Westinghouse producer-gas engine is now being installed. The generators for the arc system are two 125-light Brush machines, one 100-light Brush and one 35-light Thomson-Houston machine.

The lighting and small power generators consist of two 150-kw, one 100-kw and one 50-kw, 2300-volt, three-phase machines with 110-220 volts on the secondary; four 100-kw, six 50-kw and two 25-kw direct-current machines. The power service is 500 volts direct current, furnished by two 100-kw and one 62-kw machines. The steam turbine drives the two 150-kw, direct-current 125-volt machines. The switchboard is divided into four sections. One is for the direct current, 110-220 volts, consisting of five panels, and one for alternating current made up of 10 panels; the third section controls the power, being one large panel. The arc board is composed of three panels. The boards were made by the Hill Electric Company, of New Bedford. The ashes are given to the city for sidewalks. The coal is brought in barges direct to the plant. The boilers are hand fired.

The force required to operate the station consists of 21 men, a superintendent, a chief engineer, three engineers, two firemen, one coal passer, five linemen, six dynamo men and two oilers.

The pole lines are 197,130 ft. in length. There are 1491 poles set in the streets and 90 set on private premises. There is also considerable wire underground in conduits, the total length of conduit being 28,614 ft. The total length of wire in the conduits is 163,363 ft. Transformers for aerial lines are set on poles and are not grouped; vaults are used for those lines on the conduit system. The arc circuits are tested out every day.

The number of public lamps in use in New Bedford is 242 1200-cp lamps at $97.56 per lamp per year. There are also 16 16-cp incandescent lamps, which cost 7 cents per night. The company also lights the neighboring town of Fairhaven, where the number of lamps is 116 16 cp, costing 6½ cents per night, besides three arc lamps. The company also supplies light to the town of Mattapoisett, 7 miles away. The number of commercial arc lamps connected in New Bedford is 245 of 5 amp, 1200 cp, and 110 of 6 amp, 1200 cp. These are distributed among 65 customers. There are 38,416 16-cp incandescent lamps connected and 21 of 150 cp. The total number of incandescent consumers is 1071.

There are 246 motors connected on the lighting circuits and 60 motors on the power circuits. The total horse-power connected in motors is 589½. The largest single motor connected is a 50-hp machine driving a flour-mill grinder. During the year ending June, 1906, 1,490,222 kw-hours were generated; of this number 401,841 were for the street lamps and 812,212 for commercial consumers. Incandescent lamp renewals are furnished free by the company.

The meter department is located at the office, where a spacious room is portioned off for the purpose. When the meters are received from the makers they are tested, given a number and placed in stock. A complete card record is kept of each meter from the moment it is placed in circuit until it is sent to the scrap pile. The meters are tested in circuit, a portable testing set being used. The force of men required to operate the meter department is three. The meters are read each month by 10 men sent from the office, who are not regular employees of the company, working only part time for the company. They are paid 1½ cents an index; some of them read three books a day, there being about 200 to 300 meters in a book. These men also deliver the bills. The meter indexes are placed on a card. The consumers' ledgers are also of the card system. The gas and electric index cards are placed in the same book, so that a meter reader indexes every meter in his territory. The index books are read by different men each month.

The office of the company has a large show and salesroom and a commodious space for the bookkeeping, complaint and cashier's departments. There are also grouped around on the main floor the private offices of the executives of the company.

New Bedford has been thoroughly canvassed by the new-business department. The solicitors have made a house-to-house canvass securing information and placing it on cards, which, when turned in at the office, are placed on file. These cards call for the name and address of occupant, what illumination and power are used, reasons for not using electricity, name of solicitor and date. If a foothold is gained by the request for an estimate or any information whatever, a solicitor is immediately sent to the party and every means taken to secure the prospect as a consumer. Advice and any and all information possessed by the company are at the disposal of the prospect.

The gain in the electric business in the last two years is 4.5 per cent in 1906 over 1905, and 15.4 per cent in 1907 over 1906. As yet the power business is not quite equal to the lighting business, but a determined effort is being made to upbuild it.

One of the features of the company's methods is the matter of deposits to secure payment of bills. The amount required, of course, is controlled by the size of the installation. The lowest amount is $4. At the expiration of one year the consumer's standing is looked up and if all bills have been paid and

no trouble has been experienced, the total amount of deposit is refunded plus 5 per cent interest. If the consumer has been found to allow his accounts to run in arrears, the deposit is held.

Electric signs of all types are encouraged, although the company does not furnish them free nor handle them in any way, a reliable sign builder in the city being given all sign work. In the newspaper advertisements of the company the sign builder is referred to and vouched for by the company. All signs are erected and paid for by the consumers. New Bedford has very liberal sign ordinances. The whole city has been canvassed for flatirons and about 125 have been sold outright and are in use.

During "Old Home Week" in New Bedford last fall the company by a very liberal offer to the celebration committee appointed by the Mayor secured quite an amount of permanent business and a large amount of public confidence and free advertising. The offer was to furnish free current for all electrical-display equipment installed specially for that week. The papers were full of news concerning the electrical demonstration and contained many pictures of it. The people commented freely and very favorably on the public spirit of the company, and a great many installations remained permanent, as the merchants found that electrical advertising was of value.

Advertising is carried on extensively by the use of newspapers, circulars, descriptive matter, back of bills and special letters. The newspapers are published in three languages, English, Portuguese and French. The advertisements are changed daily and are illustrated with cuts of various appliances in use showing as near as it is possible the actual benefits of electrical service.

The company issues monthly an attractive booklet called *The Electrical Bulletin*. This has for its principal topics brief talks on methods of illumination. The remainder of the book is used for telling of the general benefits of electric service. This little book of 16 pages is finely illustrated. The back of the monthly bills contains cuts and pointed remarks concerning all the various appliances that are used with electric current, a different subject being broached each month.

The power rates are for the first 15 kw-hours per month per horse-power of demand at 12 cents; for the next 200 kw, 5 cents; for the next 200, 4 cents; for all current over, 3 cents. There is a discount of 5 per cent allowed on this rate if the bill is paid on or before the tenth of the month. The rate for signs is 10 cents per kw-hour net.

The lighting rate is 15 cents per kw-hour for the first 100 kw, 12 cents for next 200 kw-hours, and all over 300 kw at 10 cents with 5 per cent discount for payment on or before the tenth of the month. There is also a primary rate of 20 cents per kw-hour per 16-cp lamp per month and secondary rates of 7 cents and 5 cents, depending on the character of lighting, for all current over. The minimum charge is 75 cents per month per meter. The consumers have the choice of rates. When the two-rate system was placed in commission a letter was sent to each consumer which noted the equipment of the consumer, the total amount paid during the year and the monthly average. Then a comparison was made with the same equipment and consumption using the new rate. A small folder was enclosed, also a reply card. The folder enclosed with the letter explained very clearly the reasons why such a rate was adopted. To explain more clearly to the consumer just what was meant, an easily-understood example was used of the costs that entered into the manufacturing of a book, as follows:

"There are two separate kinds of cost in book making; first there is the cost of getting ready to make a book; second, there is the cost of actually making it. The former includes money paid for authorship, for setting type and making plates and illustrations, and it foots up precisely the same total, no matter whether you are getting ready to make a hundred copies or a hundred thousand copies of the book in question. The latter, the actual cost of making the book itself, such things as paper, printing, binding and so forth, after the 'getting ready' costs are paid, is always the much smaller of the two. The investment in building, boilers, engines, generators and distribution constitutes the first or 'getting ready' cost in the supply of electricity, and coal, oil, labor, etc., constitutes the second or 'actual making' costs. So, then, of two consumers taking five units of electricity a day, the one who takes the five units by the use of 20 lamps burning five hours should have a better rate per unit than the one who takes five units by the use of 100 lamps burning one hour. Each customer uses the same amount of electricity, but one requires investment for 100 lamps and the other for 20 lamps only. The two-rate system automatically gives the best average rate per unit of electricity used, to the consumer who burns his lamps the greatest number of hours each day."

Mr. Charles R. Price, the secretary and treasurer of the company, said in regard to the new business: "New Bedford has had one feature to contend against in the introduction of both gas and electric light, and that was the extended use of sperm and whale oil for lighting purposes. You would be surprised how the inhabitants clung to the use of it. But gradually by diligent work we secured a foothold, and the people, realizing the benefits of modern illumination, began to do away with the oil lamps. We believe in striking when the iron is hot and anything that can be taken advantage of in securing additional business is always eagerly accepted and made prompt use of. We believe in and have great confidence in advertising. Our soliciting force is doing good work, and the increases are satisfactory to the company. We have done very well in securing new business, and next year we hope to better our present record."

The officials of the company are: Mr. George R. Stetson, president and manager; Mr. Charles R. Price, secretary and treasurer; Mr. David W. Beaman, electrical superintendent.

Irrigation with Electrically-Driven Pumps.

BY W. P. JOHNSON.

The irrigation of land along the route of transmission lines and interurban railways for promoting the sale of electrical energy during the off-peak periods in the territory tributary to the lines is a new and profitable field for central-station managers to exploit. Scientific investigation has demonstrated that irrigation is a necessity for the proper maturing of many varieties of vegetables and fruits, and the increase in value of farm land and suburban garden tracts makes it desirable to obtain the maximum production from the soil.

By comparing the yields of two adjacent tracts, Prof. F. H. King, of the University of Wisconsin, obtained the results shown in the following table:

YIELDS PER ACRE AT EXPERIMENTAL FARM OF THE UNIVERSITY OF WISCONSIN.

	Corn, Tons.		Potatoes, Bush.		Strawberries, Boxes.		Cabbage, Tons.		Barley, Bush.		Clover, Tons.	
Year	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A	B.
1894	5.1	3.8	....	....	6,867	3,496	....	....	....	....	...	...
1895	5.2	1.3	....	....	8,732	1,030	....	....	51.00	25.00	4.01	1.45
1896	5.1	4.1	394.2	290.5	....	....	22.79	20.04	....	....	3.63	2.25
1897	4.2	3.4	333.9	212.3	....	....	....	....	45.67	44.25	4.43	2.48

A—irrigated.
B—non-irrigated.

The cost of irrigation is rarely over $3 per acre, and the great increase in yield on the investment makes the presentation on the basis of dollars and cents returned on money invested, a very profitable proposition.

The Puget Sound Railway & Power Company operates an electric road between Seattle and Tacoma. It passes through a rich valley where the principal industry is dairying and mixed farming. The writer originated the plan for creating a demand for surplus power of the company's hydro-electric system. The average cost of an electrically driven pumping plant with wooden pipe distributing system of 150-acre tract is $12 to $500 per acre. The platting of farms into 5 and 10-acre fruit and vegetable farms which is now being done is making a denser population which increases passenger traffic, and creates a demand for power at canneries and pumps, etc. Irrigation is necessary because of the light and even rainfalls when crops need it most. The plan based on irrigating a 140-acre farm in White River valley is as follows: The season lasts 100 days, and it is required to supply water to two

acres in every 10 days, irrigating 14 acres per day with water raised 14 ft. For convenience one acre covered 1 in. deep with water is called an acre-inch, and this is equal to 27,150 gal. Since it is customary to supply two acre-inches at each watering and 14 acres are watered daily, this is equal to 769,000 gal. of water. By reference to a pump table it will be shown that to be able to complete the watering in eight hours per night, the pump must supply enough water to cover 3.5 acres per hour. An 8-in. pump discharges 1600 gal. per minute or 96,000 gal. per hour, and in eight hours 768,000 gal. would be delivered. This is 8000 gal. in excess of what is required. An 8-in. pump requires 0.82 hp per foot lift and for a 14-ft. lift this is equal to 11½ hp or 92 hp-hours for an eight-hour day. For the season of 100 days, 9200 hp-hours or 6863.2 kw-hours would be required, and if energy is supplied at the rate of 3 cents, the cost for the season would be $205.90, or $1.47 per acre.

Because of the assurance of large and reliable yields owners of canneries can be induced to establish plants along the route of transmission or electric-railway lines. Wherever land is irrigated in the White River Valley by gravity flow or with gasoline-driven pumps, the yield has been doubled and often trebled.

Electric Refrigeration in Philadelphia.

By John Meyer and R. L. Lloyd.

NUMEROUS inquiries received from various electric-light companies throughout the country appear to indicate a lack of knowledge on the subject of artificial refrigeration, and the object of this article is to present the experience in obtaining and retaining this class of business in Philadelphia. To this end it has been considered advisable to go into some detail, possibly of an elementary nature, the object of the authors having been attained if some additional light is shed upon the subject. Representatives of the smaller companies are not afforded the opportunity to discuss this subject with refrigerating engineers to the same extent as the representatives of the larger companies; and, therefore, the facts herein presented may serve to help and guide the representatives of the smaller companies, and may, we hope, be of interest to others as well.

The motor-driven refrigeration machine has become quite a factor in the power field. The practical side of the subject was discussed in a paper on the "Relation of the Central Station to the Motor-Driven Refrigerating Machine," by Mr. G. W. Goddard before the Association of Edison Illuminating Companies in 1905, and by one of the authors on "Mechanical Refrigeration" before the National Electric Light Association at Atlantic City in 1906. The latter paper dealt with theory to some extent in order to enable the central station man to become more broadly conversant with the subject.

Plants are now being operated in Philadelphia in sizes from a capacity of one-quarter ton of ice, operated by a 1-hp motor, to 35 tons, operated by a 75-hp motor, in some instances there being several units in the same plant. During 1907 the connected load increased 217 per cent, operating over 230 ice-tons capacity of refrigerating machines. Additional power is required to operate brine pumps, deep-well pumps, etc., the use of such motors being necessary adjuncts; auxiliary power of this kind connected during 1907 represented an increase of 284 per cent.

In 1906 we were operating refrigeration machines in the beer saloon, grocery store, residence, drug store, dairy, butcher shop and restaurant, and to-day we are operating, in addition to the above, plants for florists, candy makers, ice-cream makers, fish and game, drinking water for office buildings, pork packers, hospitals, bottlers and fruiterers, all of these plants being in successful operation.

Table I contains data relative to the operation of the various machines, being a complete statement of the conditions one might be expected to find in the various classes. The yearly load factors as shown are determined by multiplying the actual connected load in kilowatts by 3060 hours, and dividing this result into the total kw-hours delivered during the year, the load factor being the percentage of this assumed maximum possible, or 306 days of 10 hours per day.

It has been stated that the yearly bill will be approximately seven and one-half times the highest bill. This fact is disproved by our own experience, in which the yearly bill has been found to vary from 4.3 to 9.2 times the highest month, and from 5.5 to 14.8 times the month of June. This relation will be modified somewhat by the difference in temperature of different localities, but the point to be brought out is the fact that there is no definite relation between the maximum bill and the yearly bill, the factor varying with the different classes of installation and with the difference in temperature in the different localities.

TABLE I.

	Tons.	hp.	Notes.	Yearly L. F.	Total kw-hr. year.	Monthly ave.	Largest month.		Smallest month.		Summer months ave.	Winter months ave.	Spring and fall ave.	Year=times heavy month.	Year=times June.
Dairy	15	30		48.4%	33,351	2,779	5,293	July	00	Feb.	4,801	503	3,034	6.3	7.0
Dairy	3	7	5-hp motor on bottle washer included	56.1%	15,463	1,288	2,294	July	173	Dec.	2,069	292	1,505	6.7	8.3
Residence	¼	1		47.5%	1,112	92.7	141	July	42	Feb.	135.6	61.5	83.4	7.9	8.0
Saloon	3	7½	1-hp motor on brine pump included	62.5%	12,438	1,036	1,383	Sept.	648	Feb.	1,288	677	926	9.0	10.4
Soda Fountain	3	7½	½-hp motor on pump included	61.0%	11,428	952	1,318	Aug.	713	Jan.	1,050	842	964	8.6	14.8
Hotel	4	10	1-hp on brine pump included	101.0%	25,500	2,125	2,760	Aug.	1,663	Feb.	2,604	1,687	2,084	9.2	9.2
Ice cream	2	5	7-hp on pump and ice cream machine included	54.5%	15,008	1,250	2,023	Aug.	975	Jan.	1,830	1,164	126	7.4	8.6
Meat (retail)	1	3	½-hp on meat chopper included	48.3%	3,955	329	731	July	1	Feb.	706	56	226	5.4	5.5
Meat (wholesale)	35	50		107.9%	123,906	10,325	28,492	July	0	Feb.	23,021	1,977	5,978	4.3	6.7
Florist	6	12		40.0%	11,046	920	1,419	June	580	Jan.	1,190	618	953	7.7	7.7
Butcher	6	15	2-hp on meat chopper included	26.0%	9,275	773	1,755	July	155	Feb.	1,604	208	700	5.3	6.0

It will be noticed that in the case of the dairy and the meat business, two different installations are cited, a large and a small installation in each class. It seems well to duplicate in these classes to show the relation between the different sizes even in the same class of business. The column headed "Aver-

TABLE II.

1908. Jan.	Temp. of room.	Temp. of box, at start.	Temp. of box, at finish.	Starting time.	Stopping time.	Hours operated.	Hours idle.
3	60°	41°	33°	8.30	12.30	4.00	....
4	65°	40°	32°	8.25	12.25	4.00	20.00
6	66°	41°	32°	8.25	2.25	6.00	44.00
7	66°	38°	33°	8.20	11.20	3.00	18.00
8	67°	40°	35°	8.20	12.20	4.00	21.00
9	69°	42°	32°	8.10	2.10	6.00	19.50
10	65°	39°	30°	8.35	12.35	4.00	18.25
11	65°	38°	30°	8.35	12.35	4.00	20.00
13	77°	49°	36°	8.30	5.00	8.30	43.55
14	66°	40°	32°	8.50	12.50	4.00	15.50
15	70°	39°	30°	8.50	12.50	4.00	20.40
16	63°	40°	32°	8.15	12.15	4.00	19.25
17	64°	40°	32°	9.25	1.25	4.00	21.10
18	73°	42°	32°	8.40	12.40	4.00	19.15
20	69°	44°	32°	8.25	4.25	8.00	44.45
21	70°	41°	35°	8.15	12.15	4.00	15.50
22	63°	45°	31°	8.00	12.30	4.30	19.45
23	65°	42°	32°	8.05	12.35	4.30	19.35
24	68°	40°	30°	8.10	12.10	4.00	19.35
25	64°	38°	29°	8.10	12.10	4.00	20.00
27	75°	44°	32°	8.00	3.00	7.00	44.00
28	68°	38°	30°	8.10	12.30	4.20	17.10
29	74°	42°	32°	8.30	12.50	4.20	20.00
30	55°	35°	30°	8.35	10.35	2.00	18.45
31	71°	40°	32°	8.10	12.10	4.00	22.25

age for the summer months" refers to kw-hours used during June, July, August and September; the column headed "Winter months" refers to December, January, February and March; the "Spring and fall" column applies to remainder of year.

Table II gives the actual results obtained in a small residence type of refrigerator box (shown in Fig. 1), which is cooled by a ¼-ton Brunswick machine. This detail is gone into very fully to show what might be expected in the operation of a residence-type machine. It is very easy from these data to calculate the probable cost when we know that the actual power required is 903 watts input to the motor.

We are inclined to believe that one of the largest uses which will be found for the refrigerating machine in the near future is in the cooling of drinking water for office buildings, schools and public institutions and buildings of all kinds.

Fig. 2 illustrates the equipment installed in the building of the Philadelphia Electric Company, and Table III gives in detail the figures covering the operation for a period of two weeks. The system comprises a two-ton Larson-Baker machine driven by a 5-hp motor. The expansion coils are submerged in a galvanized-iron tank having a capacity of 374 gal. This tank, located in the coolest part of the basement, is 8 ft. 4 in. long, 2 ft. wide and 3 ft. 6 in. deep. The sheet-iron sides are braced by means of angle irons, and the whole covered with hair-felt insulation about 2 in. thick. The piping is 1½ in. in diameter and laid in coils around the inside, reaching from the bottom to within 6 in. of the top. The total length is about 200 ft. coiled 16 times.

The water is fed to this tank through filters and is cooled to about 34 deg. It is then pumped through two circuits to reach the various parts of the building where the drinking fountains are located. The front loop is about 200 ft. long, reaching to the roof of the building and down again. The rear loop is about 160 ft. long and does not go above the first floor. These loops are controlled by valves at the pump, so that either one or both can be shut off if occasion calls for it. The capacity of the pump is 40 gal. per minute, which is found ample for this building. This pump is operated and the water kept in circulation all day. As will be noticed, there is generally a difference of about 2 deg. or 3 deg. between the temperature of the water as drawn at the faucet and that in the tank. This is accounted for by the hot walls and piping through which the water circulates. During a period of 20 days from Jan. 8, the refrigerating machine operated on 25.8 per cent load factor for an average operation of 3 hours and 41 minutes per day, while the circulating pump showed a load factor of 125 per cent on an average daily use of 9 hours and 7 minutes. The motor on the circulating pump is a 1-hp, series-wound machine operating at 2400 r.p.m.

The reader is referred to an article in these columns in the first issue published in the ELECTRICAL WORLD of March, 1908, entitled "Electrical Refrigeration in a Meat Market," in which the details of the equipment are discussed. The equipment, consisting of two 25-ton machines, each driven by a 50-hp Northern motor, chain-drive, is located within reach of the brine circulating pipe line of a large freezing company.

TABLE III.

RECORD OF THE DRINKING-WATER OUTFIT.

Date.	Refrigerating Machine. Time Start.	Time Stop.	Hours Operated. h.m.	Kw-Hours.	Temperature. Tank Start.	Tank Stop.	Supply.	Fountain.	Meter Dials. Start. Machine.	Meter Dials. Start. Pump.	Pump. Time Start.	Pump. Time Stop.	Pump. Hours Operated. h.m.	Pump. Kw-Hours.
Jan. 8	3.00	5.20	2.20	4.8	52°	51°	41°	..	1,890	4,260	9.30	5.50	8.20	10.40
" 9	8.45	5.05	8.20	22.2	55°	35°	..	40°	1,914	4,468	7.45 p.m.	10.10 p.m.		
" 10	8.25	3.30	7.05	17.0	33°	33°	40°	36°	2,025	4,727	8.30	5.50	11.45	12.95
" 11		Not operated.			33° in a. m.		40°	..	2,110	4,955	8.10	5.50	9.40	11.40
" 12		Sunday.									8.25	10.15	1.50	1.85
" 13	8.30	3.10	6.40	20.2	36°	36°	41°	39°	2,110	4,992	8.15	5.50	9.35	10.55
" 14		Not operated.			32° in a. m.		42°	39°	2,211	5,193	8.15	5.50	9.35	11.75
" 15	9.00	4.00	7.00	18.8	49°	34°	42°	40°	2,211	5,428	8.10	5.45	9.35	11.25
" 16	4.00	5.20	1.20	3.6	32° in a. m. 48°	44°	41°	50°	2,305	5,653	8.15	5.50	9.35	10.65
" 17	9.30	2.50	5.20	13.8	48°	35°	41°	43°	2,323	5,866	8.05	5.45	12.05	13.00
" 18	9.10	1.20	4.10	11.2	43°	36°	40°	41°	2,392	6,073 6,126	7.45 p.m. 8.10	10.10 p.m. 4.30	8.20	7.70
" 19		Sunday.												
" 20	2.55	5.15	2.20	6.4	36° in a. m. 43°	35°	40°	39°	2,448	6,280	8.20	5.50	9.30	8.75
" 21	2.55	5.10	2.15	5.8	33° in a. m. 42°	37°	41°	40°	2,480	6,455	8.20	5.45	9.25	7.70
" 22	10.30	4.10	5.40	15.8	34° in a. m. 39°	35°	41°	40°	2,509	6,609	9.00	5.50	8.50	9.30
Totals			52½	139.6									118 1/12	126.75

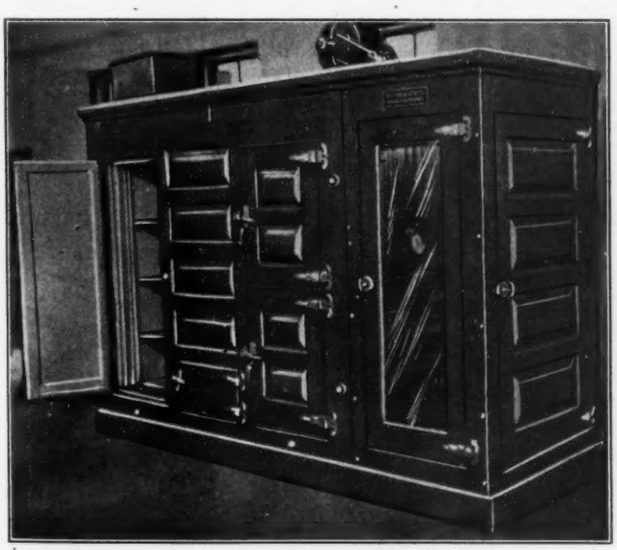


FIG. 1.—RESIDENCE TYPE REFRIGERATOR BOX.

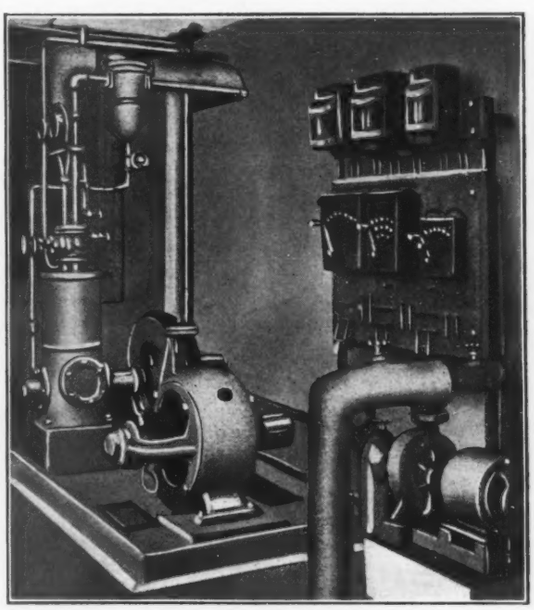


FIG. 2.—TWO-TON REFRIGERATING MACHINE.

One of the difficulties encountered in the securing of refrigeration business is the overestimating of the requirements on the part of the engineer and the architect. In general, the architect is dependent upon the user or the consulting engineer for his information, and in many instances is misled by the lack of knowledge on the part of the former and the desire to see a steam plant installed on the part of the latter. In this particular instance the plant has never been operated near its maximum capacity, the average requirements being considerably below the estimates, and in consequence, from the standpoint of efficiency, it presents a somewhat unfavorable condition as regards economical operation.

Generally speaking, electric drive is more economical to operate, and in addition has the advantage of being available at all times, is a clean and simple source of power, and readily understood and operated by even the ordinary attendant. At the prevailing price of ice, the cost of electric energy is about one-half that of ice.

It is with the ice-cream maker that the greatest saving is frequently shown through the adoption of artificial refrigeration

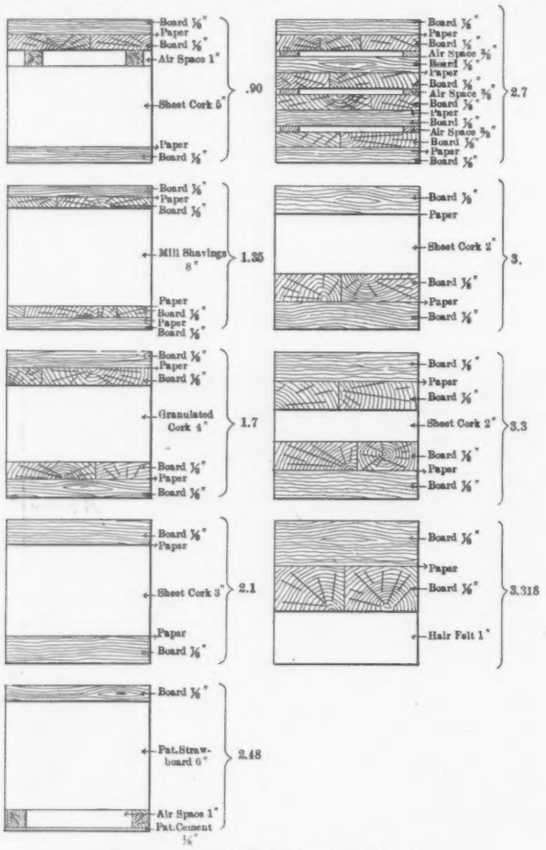


FIG. 3.—REFRIGERATOR INSULATIONS.

owing principally to the saving in both ice and salt bills. It is an acknowledged fact that in the ice-cream business the use of ice is very extravagant. An article published a short time ago in the *Ice Cream Trade Journal* treats of an installation in a retail ice-cream saloon having a capacity of about 400 quarts of ice cream per day during the summer. The investment for some new cabinets and the refrigeration outfit complete amounted to $2,700. After operating the electric refrigeration machine a comparison was made with the costs involved during the same three months of the previous summer when ice and salt were used. The cost of electric power, together with the cost of water and 15 per cent of the investment as a fixed charge, indicated a saving of $427. During the remainder of the year the saving would not be so great, this remarkable showing occurring at the time of maximum business.

Each of the representatives of the various machines make claims and statements which would seem to indicate that his machine is superior to all others. Our experience indicates that there is very little actual difference in the results obtained from the different makes of machines, but that the manner in which the equipment is planned and installed has much to do with the giving of good or poor results. Further, we have found that some representatives seem to prove more successful in one line of business than in another. For instance, one representative has made a specialty among the meat dealers, another with dairymen, a third with candy manufacturers, and so on. Again one man is very successful in small sizes of machines, while others do not seem to be able to properly take care of the small installation. Therefore, we say that above all it is important to have a thoroughly competent refrigeration engineer who has had experience in his particular line to superintend an installation.

Too much importance cannot be attached to the proper insulation in all cases. There seems to be a prevailing opinion among the laity that what ice fails to accomplish, a refrigerating machine can perform. Again, we often hear that an agent will refuse to put in a machine unless the insulation is improved. Both positions are unwarranted.

If we glance at the formula which is used in calculating the amount of refrigeration required, it is at once apparent what a large factor insulation is in the result. The formula is as follows:

$$H = c\,A\,(t - t^1).$$

In this formula A is the outside surface area of the box or space to be refrigerated; t is the temperature of the surroundings, and t' is the temperature desired in the space to be refrigerated; c is a factor which varies from 1 to 7, dependent on the quality of the insulation separating t from t'. If the insulation is very good, the factor c, which multiplies the result, may be one-seventh as much as in the very poorest insulation. The value of c for an average fair insulation is taken at 3, and the result then is the number of thermal units (British) to be taken care of. Fig. 3 illustrates the construction and values of insulations, the latter varying from .9 to 3.318.

There are 285,000 thermal units required for the melting of a ton of ice. If, therefore, we divide the value of H obtained above by this figure we get the size in tons of the machine required. For example, assume a meat box 10 ft. x 10 ft. x 10 ft., the outside area of which is 600 sq. ft. The temperature desired inside is 34 deg., the probable maximum temperature outside we can assume to be 84 deg.; $t - t'$, or the difference in temperature between the outside and the inside is thus 50. We will assume that c has a value of 3 in this case. $H = 3 \times 600 \times 50 = 90{,}000$. $90{,}000 \div 285{,}000 =$ approximately one-third of a ton. This means that 1/3-ton machine would have to operate 24 hours per day to maintain the desired temperature in the box. As it is undesirable to operate the machine continuously, the same results may be obtained by using a 1-ton machine for, say, about eight hours per day.

Supposing the insulation were poor so that c instead of being taken at 3, were taken at 6, the leakage from each square foot of surface would be equal to 6 instead of 3 thermal units per hour. The value for H now becomes 180,000 and the machine required is one of two-thirds of a ton for 24 hours' operation, or for an eight-hour operation a two-ton outfit would be necessary. This would mean not only a greater increased cost for installation, but a continually higher expense for operation, which would be almost in a ratio of 2 to 1. It is thus very evident that it would be very much more economical to spend even $100 additional on the insulation of the box.

The above deductions do not take care of the contents of the refrigerator boxes, the idea being to illustrate the method of calculation and the importance of good insulation.

The following formula provides for the heat units contained in the materials placed in the boxes. Adding together the results obtained by the two calculations we secure the tons of refrigerating capacity required.

$$\text{Tons} = 0.000003505\ (w\,s)\ (t - t^1)$$

w = weight of material in lb.

s = its specific heat.

t and t^1 = same as before.

Assume that the above box contained one ton of meat.

The specific heat of beef is 0.8. We will assume that the meat is brought directly from the packing house and that the temperature has risen to 50 deg., and that, as before, $t^1 = 34$ deg.

We then have $0.000003505 \times 2000 \times 0.8 \times (50 - 34) = 0.089728$ ton. Multiplying this result by 3 to obtain the result in 8 hours we get 0.269 ton of capacity to take care of the contents. This is unimportant in this case and can easily be taken care of by the machine already decided upon.

But this is not always the case. In the case of a butcher killing his own beef, a large allowance is found to be necessary, and similarly in the butter business, and with milk that has just been pasteurized.

In conclusion, attention to the suggestions offered in this and in preceding papers will do much to develop electric refrigeration, and the results will surely compensate the majority of the companies for the time and effort expended.

Economical Operation of Small Generating Stations.

At the Chicago convention of the National Electric Light Association, held in Chicago, Messrs J. T. Whittlesey and Paul Spencer presented a paper discussing the design and operation of small central stations. Since many of the so-called labor-saving devices are applicable only to stations of large size, and each additional piece of apparatus in the station is an additional source of possible trouble and cost, the simple design is always the safe one for the small station. Simplicity of design, however, does not mean lack of design, and it is probably of even more importance in the cost of the small plant than of the large plant that it should be arranged at the start so that it can be developed along definite lines.

Every station manager should forecast for himself the development of the load so that he may have some idea of the conditions it will be necessary for him to meet from year to year in the future. It is an excellent plan to assume some reasonable percentage of growth in order to ascertain what point at the end of a period, say 10 years, the expected load on the station may reach, and to draw up some tentative plan to meet such an estimated load, working backward on the problem to ascertain when the additional apparatus will have to be installed, in order that the equipment may keep pace with the growing load.

With such a more or less definite plan in mind the extensions can be made from year to year in the most economical manner, so far as first cost is concerned, and with a uniformity in the design and size of apparatus that will help toward efficient operation. Such a definite plan will also enable the station manager to avoid the costly rearrangement of buildings and of apparatus, which have so frequently been necessary in the past and have swelled so much the station's scrap pile.

It should be remembered that in the future the question of replacement may have to be handled on quite a different basis, so far as the method of charging the cost is concerned, than in the past. Everything points to the fact that all companies, sooner or later, will be operating under restrictions imposed by State commissions and that the value of displaced apparatus can no longer be charged to capital account, as has been done in many cases in the past, but will have to be taken up in some way in the operating account of the station. It, therefore, becomes of the utmost importance that each station should be able to grow along definite lines, utilizing to the end of its useful life all the apparatus it may possess.

EXTENSIONS OF OLD PLANTS.

It is, of course, comparatively easy, if any thought whatsoever be given to the subject, to lay out a new station to provide for some such definite method of growth. Electrical apparatus has now reached such a point of development and of standardization that replacements, due to the changes in the art, are much less likely to occur in the future than in the past.

It is a more difficult problem with an old station, which in many cases is merely a haphazard collection of all sorts and conditions of apparatus, to provide a definite plan to bring order out of chaos. It is, however, always possible to provide that the extensions shall be carried out with some plan in view, and generally possible to make this plan one that will fit in more or less successfully with the existing station. The central-station manager should recognize the extreme importance of his making, as early as possible, an intelligent study of future development and of providing a systematic plan to which he may work.

Assuming that a new station is to be built, certain broad

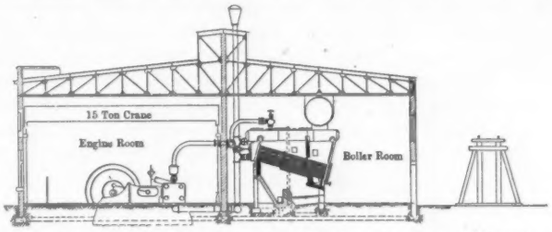


FIG. 1.—CROSS-SECTIONAL ELEVATION OF SMALL STATION.

features of the design can be laid down as essential. First of all, the plant will undoubtedly supply alternating-current service, generating and distributing at 2300 volts, polyphase, 60 cycles. One class of apparatus only should be installed, and the entire business, whether for commercial lighting, street lighting or motor, should be supplied at 60 cycles.

A site should be selected that will have railroad facilities and, if possible, a supply for condensing water, as a condensing plant will be desirable when the load has increased to a certain point. The site should be of suitable shape and sufficiently large to provide ample facilities for future extensions. It is also desirable that there should be room on this property for stable or store room, as economy in the entire operation of the company will be gained by having all such buildings located at one point. The site chosen should, if practicable, be close to the center of the town. The design of the engine and boiler room should, of course, provide for unlimited extension. This means parallel engine and boiler rooms. The station building should be fireproof, with brick walls, concrete floors and steel roof. A crane in the engine room is desirable, but not necessary. The gutters and flashings should be of copper, and win-

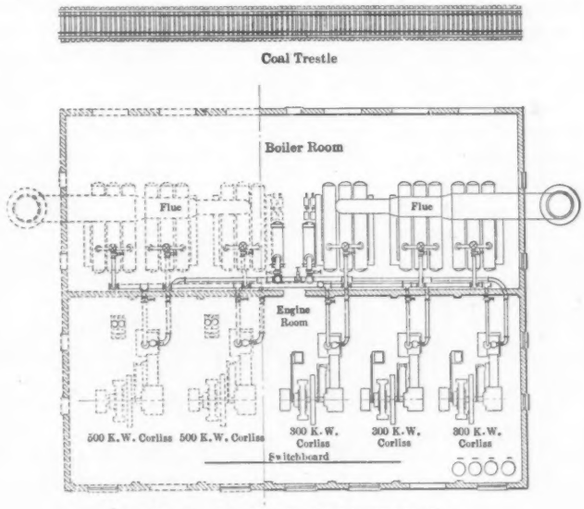


FIG. 2.—PLAN OF SMALL STATION.

dow frames, doors, hardware and other details should be substantial, so as to keep down the cost of repairs.

The stack should be of brick, as steel stacks will in every case be found to be more expensive in the end, because they require a constant maintenance charge for painting and sooner or later they must be replaced.

For a small load, say under 1000 hp, a simple non-condensing station will show the least total outlay, including cost in operation, and interest and depreciation on the apparatus installed.

Consideration should also be given to the fact that in such a station, with only a small number of men employed, it is impossible to obtain, for the wages paid, very expert men and that, therefore, the best results will be obtained by keeping all the apparatus as simple as possible.

The generating unit should be direct-connected with the engines, preferably of the Corliss type, of moderate speed. The boilers may either be fire-tube or water-tube, but should be hand-fired, with no elaborate machinery for handling fuel or ashes. The station auxiliaries should be reduced to a minimum.

The exciters will be belt-driven from the engines, and the only steam auxiliaries will be a feed-water heater and feed pump.

The switchboard design should provide for exciter panels, located in the middle of the board, with sufficient space left for all future extensions. A Tirrill regulator will be found most desirable. Its first cost is low, and in a station where labor is to be reduced to a minimum it will be necessary to have such a voltage regulation if good service is to be given. With the exciter panels located in the middle of the switchboard, the generator panels may be extended as needed on one end and the feeder panels on the other. All connections from the generators to the switchboard should be carried in cable under the floor, and the outgoing feeders should also be carried under the floor to a wire tower at the corner of the building.

Fuel should be delivered to the plant on a railroad siding extending the length of the boiler room and parallel to it. If possible a trestle should be installed, so as to provide headroom for dumping the coal from the cars, which can be stored under the trestle and wheeled to the boiler room as needed. Sufficient space should be provided under this trestle to permit of carrying not less than a month's supply of coal at the time of the station's maximum output.

PROPOSED PLANS.

A general plan of the station embodying the above general ideas is shown in Figs. 1 and 2.

It will be noted upon examination of these drawings that the building suggested, which is extremely simple in design, contains no basement, either under the engine or the boiler room. The steam piping is placed overhead with the exception of the free exhaust lines from the engines, and the arrangement is such as to give the shortest possible length of connections from the boilers to the engines.

The omission of a basement is primarily to reduce cost, but it will also result in cheaper maintenance, as it is found that basements in such stations usually become filled up with rubbish which must be cleaned out, and when used to run pipes in, the work of repairs on them is greater than where the pipes are placed overhead. Leaks frequently are allowed to exist, causing constant loss, which would otherwise be immediately noticed and stopped.

While an ash hopper and basement under the boilers keep the boiler room clean and enable more rapid and easier cleaning of fires, they increase the cost of getting out ashes and give additional space to be kept clean. The additional cost is practically prohibitive.

The solid portion of Fig. 2 indicates the building as it would be constructed for immediate needs; namely, a maximum load of 600 kw, containing three 300-kw units. The future extension to take care of the growth in load for 10 years is indicated by dotted lines.

This sketch is given simply to indicate the general features of the type of station recommended in this paper; the details, of course, would be altered to meet local conditions and requirements.

It is assumed that this station is to be built to meet a present maximum load of 600 kw; that this load will be increased at the rate of 10 per cent per annum compounded, and that the load factor will be equivalent to 2200 hours per year for each kilowatt of the maximum demand. This station can be built at a cost of from $125 to $150 per kilowatt.

Assuming the available output as the amount obtainable when the largest unit is disabled and the others are overloaded by 25 per cent, the original installation of three 300-kw units would carry the load safely through three years with one unit out of service, at which time a 500-kw unit would be installed, which would carry the load for five years; a second 500-kw unit would then have to be purchased, which would give an available output more than sufficient to carry the load through the remaining three years.

The complete plans of the station, including the dotted portion, show all of these units installed, with necessary boiler installation. Such a station would have a total output, with the largest engine out of service, of 1750 kw, allowing a 25 per cent overload on the units available for service.

There is given in Fig. 3 an assumed load curve for an average maximum day. On this sheet is also shown the rating of gen-

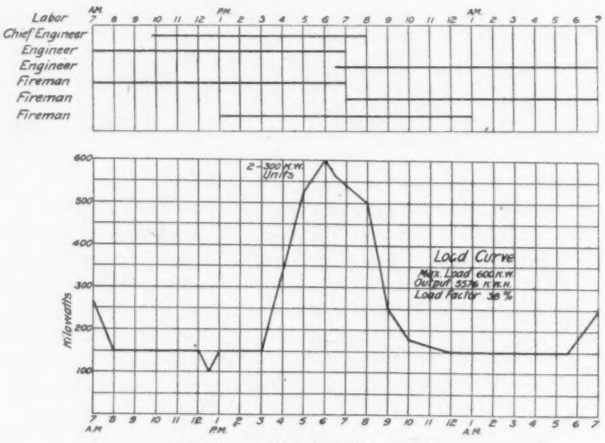


FIG. 3.—STATION LOAD CURVE.

erators running to meet the load, from which it will be seen that the 300-kw unit will be running at approximately half-load during the light portions of the day and night. This would, of course, increase the fuel consumption during these hours over what it might be with a small unit of exactly the necessary size to meet the present load. It is expected, however, that in a very short time the day load would be increased so that the 300-kw unit would be operating under more economical conditions. Should the territory in which the station is operating be of such character that it is impossible to obtain any great amount of day load, it would be desirable, perhaps, to install a somewhat smaller unit than that shown on the plan.

OPERATION.

The operation of such a plant would require a minimum of labor and repairs. From experiences with similar plants, it is learned that a total of six men is amply sufficient, including one chief engineer, two running engineers, two firemen and one fireroom helper. The hours which these men should work are shown in diagram on the load-curve sheet. By lapping the chief engineer and the helper, we should have four men in the plant over the peak of the load.

The overlap covers the afternoon hours, giving the chief engineer the best opportunity to overhaul apparatus and providing him with the necessary help to carry on his minor station repairs.

With the plant as described, there will be practically no continuous repair work, with the exception of that required to keep the boilers in first-class condition. There will be only two single-cylinder, slow-speed engines and one boiler-feed pump running simultaneously during the peak, and only one engine and one feed pump for 20 hours of the day.

As this is a non-condensing plant, the steam pressure will be low, not over 120 lb., which will make it possible, with a small amount of labor and attention, to keep the piping, valves, packings and so forth, in perfect condition, so that there should be no excuse for their not being maintained always at initial efficiency, even with the small station force employed. When the engineer of a station is relieved of the care and annoyance ordinarily caused by condensing apparatus, mechanical stokers,

forced draft and other complications, his whole attention may be given to maintaining the efficiency of the boilers and engines and seeing that they are operated to the best advantage under the load conditions.

OPERATION.

The following particular points are brought up as essential to the economical operation of the station:

In the engine room it will be important for the chief engineer to see that the rating in apparatus running follows closely the load curve. All units should be run at their highest possible efficiency. It is always desirable to run them overloaded rather than underloaded, and the engineer should not be afraid of running the units at their full overload point.

The chief engineer should be provided with an indicator and take frequent cards so that he may know at all times the condition of the valves and cylinders and remedy any defects that may develop.

It is in the boiler room that the greatest possibility lies of wasting or saving fuel and improving the station economy. No positive rules for firing can be laid down in general on account of the difference between fuel and also on account of the various methods of firing adopted by different men.

The cutting in and out of boilers and banking of fires must be watched as closely as the running of the engine room to make the boiler rating meet the loads most economically. With most boilers of good design it is found more economical to overload them 25 per cent above the builder's rating and in order to carry a short peak to go to 50 per cent or more overload rather than cut in an additional boiler. The slight falling off in efficiency of a boiler at these high ratings does not consume as much fuel as that required to keep one boiler banked for use for a few hours a day.

With a non-condensing plant there is no difficulty in getting the temperature of the feed water above 200 deg., so that this point will not trouble the engineer.

The combined boiler efficiency, including the grate and heating surface, can be kept up to the highest point only by constant attention to the condition of the boiler setting and the tubes. Draft gages and thermometers, which cost but little and are very simple to use, will give the engineer exact information with regard to the condition of the boiler and will help the fireman to get the best results from the boiler and the coal. A thermometer should be installed on the feed line into the boiler and draft gages on uptakes and immediately over the fire. A high-reading thermometer for observing the temperature of flue gases should be used by the engineer occasionally, which will be a guide on the efficiency of the boiler. Periodical readings of the draft at different points through the boiler should be made to determine the loss of draft and ascertain if the air leaks are excessive.

One great source of loss of boiler efficiency is the bad condition of boiler-setting, cracks around drums and other points in the setting which admit cold air, decreasing the draft and lowering the temperature. Most plants have an excess draft available from the stack, so that even with a very bad condition in this respect ample draft is still obtainable for burning the coal as fast as is required. This results in a continuous loss unknown to the engineer, unless investigation with draft gage or by torches is made.

Every one is perfectly familiar with the necessity of keeping the boiler clean, both inside and out, to maintain its efficiency. The frequency of such cleaning will depend entirely upon the quality of fuel and water used. An increase of 10 per cent in boiler efficiency can easily be made, even where conditions are not very bad, by repairing the setting and cleaning the boilers.

An automatic damper regulator is essential, especially in a small plant where natural draft is used.

STATION RECORDS.

It is hardly practicable in a small plant for the engineer to make elaborate tests, flue-gas analyses, engine-efficiency or evaporation tests, but the total running results of the plant can be kept very accurately by a proper method of records. The chief engineer is not responsible for two factors greatly affecting the cost, namely, the nature of the load on the plant and the fuel furnished. He can, however, by keeping accurate records, furnish the management with the information necessary to determine whether or not the fuel purchased is the best for the price and how the cost of production can be decreased by improving the load factor. No scientific test is as good as a comparative run of several months under similar conditions.

In many plants of this size the output and the shape of the load curve are very similar from day to day and from month to month, so that, by ascertaining the amount of coal burned and the output, a very accurate comparison can be made with different fuels, methods of firing and handling of the units.

It is essential, then, for the economical operation of a small plant that watt-hour meters be installed on each generator and the daily output kept on the log sheet. The indicating instruments should also be read at sufficiently frequent intervals to enable a daily load curve to be plotted. Every pound of coal and ash should be weighed and a record kept for each shift or period of load.

The engineer will have payrolls and bills for material, so that with a very small amount of bookkeeping he can determine the actual cost of labor, fuel, oil and waste, repairs to buildings, repairs to engines, repairs to boilers, and repairs to electrical apparatus.

It is hardly possible in such a plant to subdivide the labor, as the ordinary repair work and maintenance of apparatus is done by the regular station help, part of whose time is also put into operating. Any extraordinary repairs requiring outside help or machine work will be entered up separately.

The engineer of the plant should not hesitate to try experiments in operating, provided, of course, the service is not endangered; such as different hours of cutting-in and out boilers, overloading and underloading boilers, cutting engines in and out on the load at different hours. These experiments will be of no value, however, unless they follow out a definite program to its final results and unless records are kept accurately and analyzed intelligently to compare the results obtained. Conclusions are often jumped at in station operating which at sight seem apparently correct, but upon analysis prove to be entirely wrong. Good records and a careful analysis are the only proofs that can be accepted.

OPERATING COST.

Item.	Present output — Amount.	Present output — Per kw-hour.	Double output — Amount.	Double output — Per kw-hour.
Superintendent	$1,000	0.0757 cent	$1,000	0.0379 cent
Labor	5,040	0.3819 "	6,480	0.2454 "
Fuel	9,723	0.7366 "	19,446	0.7366 "
Water	634	0.0480 "	1,268	0.0480 "
Oil and waste	600	0.0454 "	800	0.0303 "
Miscellaneous supplies and expense	500	0.0378 "	600	0.0227 "
Repairs, buildings	100	0.0076 "	100	0.0038 "
Repairs, steam	700	0.0530 "	1,000	0.0379 "
Repairs, electrical	75	0.0057 "	100	0.0038 "
Total	$18,372	1.3917 cents	$30,794	1.1664 cents

NOTES.—Coal based upon Pennsylvania bituminous at $3 per ton, 5.5 lb. per kilowatt-hour.
Water based upon cost at 10 cents per thousand gallons, 40 lb. per kilowatt-hour.
Superintendent's salary at $3,000, one-third charged to production.
Labor: Chief engineer at $1,200 per year.
Two engineers at $900 per year.
Two firemen at $720 per year.
One helper at $600 per year.

IMPROVING OLD-PLANT RESULTS.

In the case of an old plant which is not operating at good efficiency it is difficult sometimes to locate the trouble and correct it. It is, of course, necessary at first to secure accurate records as already described. These, however, will show only the total pounds of coal per kw-hour and will not tell where the losses are.

The easiest point to be attacked first is the engine economy, which can be very readily brought up to its highest possible point with the engines in use. The records will then show if any gain in efficiency has been made.

After having brought the engines up to their best efficiency for the type, the boilers should then be carefully inspected and

cleaned up. Boilers that have been neglected will require heavy expenditures to bring them up to a good standard of efficiency. This, however, must be done if the manager is determined to get good results from the plant in the end. No patching or partial cleaning of a boiler should be made unless it is absolutely necessary at the time in order to keep them in operative condition. Thorough repairs only will pay, but they will pay well in fuel saved, as the records will show if they are properly kept.

The operating costs of a small plant are given in the table on previous page. The figures are conservative for a new plant, well-built along the design suggested, and have been exceeded in actual experience. Two columns of cost are given: first for a station having a load of 600 kw and an output of 1,320,000 kw-hours per year, and the other for the same station with twice the output and the additional equipment necessary.

The figures for labor and fuel will vary considerably in different localities and under different conditions of the labor and fuel market.

The Law of Electric Light Companies.

By J. E. Brady.

INJURIES TO PERSONS ON STREET.

It is well settled that damages may be recovered against an electric-light company when a person while on a public thoroughfare is injured through the negligence of such company. Amer. & Eng. Encyc. of Law, Vol. X, p. 870.

A company of this kind, using a thoroughfare or public highway for the purpose of its business, is charged in law with great care, not only in erection of the wires, but in maintaining and keeping them in repair. They must be so kept and conducted that a citizen pursuing the ordinary vocation of life will not come in contact with them. It is the business of the company to so erect them as not to interfere with the safety of the citizens of the community while pursuing their vocations in the ordinary walks of life. Mitchel vs. Light & Power Company, 45 S. Car., 146.

In Lundeed vs. Livingston Electric Light Company, 17 Mont., 32, the facts were these: An electric-light company, in order to strengthen and support one of its poles, ran a guy wire from the pole to a post planted across the street. This post was from 4 ft. to 6 ft. high, and the guy wire was fastened around it 4 ft. or 5 ft. above the ground and extended thence to the pole across the street. One day when the acicdent for which the action was brought occurred, the plaintiff was riding at a moderate gait on horseback along the street. Near the place where the post and guy wire had been put up, a man by the name of B., also on horseback, passed the plaintiff. Here B.'s horse became frightened and for a time unmanageable and shied across the street and ran against the guy wire and broke it near the post to which it was fastened. The broken wire recoiled and wound itself around the waist of the plaintiff, who was riding in the rear of B., pulling her from her horse to the ground and inflicting upon her serious injuries. It was held that the post with wire was an obstruction of the free use of the street in its ordinary and usual use, that such obstruction was the approximate cause of the injury, and that, therefore, the plaintiff was entitled to recover damages. Amer. & Eng. Encyc. of Law, Vol. X, p. 870.

In Excelsior Electric Company vs. Sweet, 57 N. J. L., 224, the plaintiff was passing along a public street on his way to market. When he reached a point in the street over which a lamp of the defendant (an electric-light company) was suspended, it fell and struck his horse. The horse became frightened and ran away, throwing the plaintiff from the wagon whereby he was injured. There was evidence given by experts that the rope used for keeping the lamp in its place was not a proper and safe rope, and that the pulley over which the rope ran, unprotected as it was, was unsuitable, and that the suspension wire used had not the "stoutness or durability to have a lamp like that hanging on it." It was held that the plaintiff was entitled to recover damages.

An electric-light company is guilty of negligence in leaving a broken uninsulated telephone wire in such a position as to endanger the lives of persons using the street; and when the plaintiff's husband, in the proper discharge of his duty as a police officer, while attempting to remove the dangerous nuisance, was brought in contact with the charged wire, and thus without any negligence on his part lost his life, the company was held liable to respond in damages. Dillon vs. Allegheny County Light Company, 179 Pa. St., 482.

The employees of an electric-light company, while engaged in taking down a wooden electric-light pole, lost control of it with the result that it fell upon and seriously injured the plaintiff, who was crossing a public street. The plaintiff introduced evidence to prove that the men engaged in taking down the pole failed to exercise the care required by the circumstances and that the appliances used in the performance of the work were inadequate. It was held that the plaintiff was entitled to recover damages. The court said: "It was the duty of the defendant to furnish sufficient men and adequate appliances for the work of taking down the pole, and it was liable for the consequences of its failure to do so. If it discharged its duty in this respect, it was still answerable for the consequences of the negligence of its employees in the performance of the work." Kyle vs. Southern Electric Light, etc., Company (Pa., 1896), 34 Atl. Rep., 323.

While the plaintiff in an action against an electric-light company was lawfully passing along one of the public alleys of the city, without any fault on his part, he came in contact with a live wire belonging to the defendant company, which wire had become disconnected and detached from its overhead fastenings, and was hanging down to within about 2 ft. of the ground. As the result of such contact, the plaintiff received a severe shock and was seriously injured. The negligence charged against the defendant company, of which there was some proof, consisted in its failure properly to construct its line and its omission to take the necessary precautions to prevent the wires from falling and causing injury in case they became detached from their fastenings. Judgment was here given for the plaintiff. In the opinion, it was said: "That the business of distributing electricity on wires strung over the streets of a city is a dangerous business attended by peril to travelers along the highway, and the necessary precautionary steps to guard the public must be taken." Denver Electric Company vs. Simpson, 21 Colo., 371.

As a rule, where an electric-light wire falls from its proper place and injures a person passing in the street, negligence is not to be presumed from the mere fact of the falling. The rule cannot be better stated, in its generality, than as given in Scott vs. Dock Company (1865), 3 Hurl. & C., 596: "There must be reasonable evidence of negligence. But where the thing is shown to be under the management of the defendant or his servants, and the accident is such as, in the ordinary course of things, does not happen if those who have the management use proper care, it affords reasonable evidence, in the absence of explanation by the defendants, that the accident arose from want of care." Public policy, from sheer necessity, must require of a person or corporation using a current of electricity in high tension along highways, a very high, if not the highest, degree of care, and this high degree would seem all the more reasonable to justify this rule of presumptive negligence in such cases. A wire may have some defect which the most astute care will not discern. A wire originally good may come to be defective, and break, when no human skill could detect its defect. Time and wear deteriorate man and all the means and instruments he uses to gain a living. Paralysis and failure may come upon them at any moment. Whether there is culpable blame is a question for a fair-minded jury.

INJURIES TO PERSONS RIGHTFULLY ON PREMISES.

When a person who, though not upon a public street, is on premises where he is entitled to be in the pursuit of his business, is injured as the result of negligence on the part of an electric-light company, he may hold the company for damages. Amer. & Eng. Encycl. of Law. Vol. X, p. 871. Thus, where a

person employed in a hotel was requested by his employer to accompany him upon the roof of the building in the night time for the purpose of fastening some signs which were in danger of being blown down, and the employee, in the darkness, accidentally came in contact with the wires which supplied the hotel with electric light, and upon which the insulation was defective, the company owning the wires was held responsible for the injuries received. Giraudi vs. Electric Improvement Company, 107 Cal., 120. In Griffin vs. United Electric Light Company, 164 Mass., 492, the plaintiff was a tinsmith and, at the time he was injured, was at work with a fellow-servant placing a galvanized-iron conductor on the rear of a building known as the American House. He was standing upon the ground and his fellow-servant was on a ladder near the roof of the building, which was about 20 ft. above the ground. The wire from which the plaintiff received the shock ran along the wall of another building and then ran diagonally across to the wall of the American House, which it entered at a point about 6 ft. from the ground. Inasmuch as the plaintiff was rightfully upon the premises at the time of the accident, it was held that the electric-light company was legally responsible. Quoting from the opinion of the court: "The plaintiff was not a trespasser, or a mere licensee, who must take the premises of another as he finds them. He was rightfully on the premises for the purposes of business. On these premises the defendant had rightfully placed, as the case finds, two electric wires. These were a source of danger unless properly insulated. This fact was recognized by the defendant in insulating them. But it was negligent if it failed to use reasonable diligence in seeing that its wires were kept in a state of repair. This duty it owed at least to every person who, for the purposes of business, was rightfully upon the premises."

The electric-light company was held responsible in damages where a house painter, while in the act of climbing out of a window for the purpose of painting the house, came in contact with an uninsulated electric-light wire, belonging to the company. McLoughlin vs. Louisville Electric Light Company, 37 S. W. Rep., 851. And a policeman was held to have a cause of action against an electric-light company, where he was injured while on duty in a bank, where he was injured by an explosion in a brass pipe, through which ran one of the company's wires, the explosion having been occasioned by a contact outside of the bank between the wire which ran to the bank and a wire carrying an arc current. Yates vs. Electric Light & Power Company, 40 La. Ann., 467. In the case of Ennis vs. Gray, 87 Hun. (N. Y.), 355, the plaintiff, who was a roofer by trade, was injured while at work upon the roof of a building under the authority of the owner of the building, by coming in contact with the wires of the defendant company, which were used for carrying an electric-light current and which were defectively insulated. It was held that the plaintiff was entitled to recover. The court said: "The defendant was engaged in the business of supplying electricity for lighting purposes in houses and streets of the city, and considering the high voltage which it was necessary to carry over the wires, thus rendering the business in the highest degree dangerous unless handled with skill and care, we think that outside of any contractual relation, a duty was created on the part of the defendant, not only toward the public generally, who in the streets of the city might be likely to come in contact with the wires, but also with respect to any individual engaged in a lawful occupation in a place where he was entitled as of right to be."

INJURIES TO TRESPASSERS.

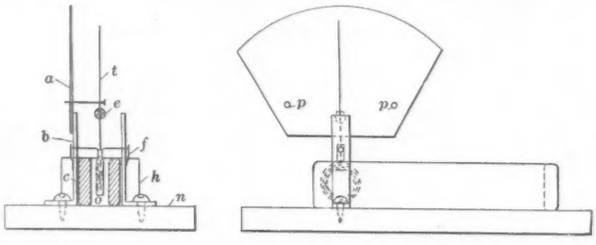
A person who is injured by coming in contact with an electric-light wire, improperly insulated, while in the act of committing a trespass, or in a place where he has no right to be, is not entitled to damages. Amer. & Eng. Encycl. of Law, Vol. X, p. 872. In Hector vs. Boston Electric Light Company, 161 Mass., 558, a lineman in the employ of a telegraph and telephone company was sent to attach a wire to a standard owned by an electric-light company on the roof of a building numbered 45. Instead of entering this building and going upon the roof, he went up through the building numbered 29 and passed over the roofs of the several intervening buildings until he came to the roof of No. 41, which was next to but higher than the roof of No. 45. A number of wires ran from the standard on No. 45 over a small portion of the roof of No. 41. The plaintiff stooped under these wires to see how he could get on the roof of No. 45 and was injured by reason of the insulation being worn off from one of these wires. It was decided that the defendant owed no duty to the plaintiff to maintain an effectual insulation of the wires over other buildings than that on which its standard was placed.

Device for Testing Watt-Hour Meter Armature Circuits.

BY L. D. SNOW.

The make-up of a home-made and inexpensive device for testing the circuits of high-resistance armatures such as are used in direct-current watt-hour meters is shown in Figs. 1 and 2 herewith. In such armatures on account of there being two circuits from one commutator segment to the next segment, a magneto will fail to indicate an open circuit in one of the circuits or a short circuit between commutator segments, both of which affect the calibration of the meter in about the same manner.

Referring to Fig. 1, *h* is the drag magnet past usefulness in a meter, having lost part of its original strength; *o* represents about 10 turns of, say, No. 29 magnet wire taken from an open-circuited potential coil of a high-torque induction meter of the Thomson type, and made to pass with plenty of clearance between the jaws of the magnets. The ends are brought above the magnet and bent at right angles to the coil, passing through holes in the supports *b*. This provides an axis about which



FIGS. 1 AND 2.—TESTING DEVICE FOR WATT-HOUR METER ARMATURES.

the coil can swing parallel to the jaws of the magnet. The insulation is removed from these ends where they rest on the supports *b*, thus allowing current to pass from one support through the coil *o* to the other support. At *f* a strip of brass is soldered to the supports to take care of any side thrust of the coil. A short wire *t* is fastened to the coil for a pointer on which is placed a weight *e* to counterbalance the weight of the coil. The supports *b* are insulated from the magnet by paper as indicated at *c*. A wood base *n* supports the mechanism and *a* is a cardboard background for the pointer; pin stops are provided at *p*.

By connecting this device in series with two or three dry cells and with pin points at the ends of a pair of flexible leads, the circuits can be tested out between commutator segments. In Fig. 2, with the pin points touching on the commutator segments *a* and *b*, the circuit through coil *E* will have about one-eighth of the resistance of the circuit through the other coils. If the device is properly made, coil *E* "closed" will give a good deflection of the pointer; but if coil *E* is "open" the other circuit, owing to its high resistance, will not give a deflection. A "short" between the segments *a* and *b* will show by a decided movement of the pointer. Sometimes two coils such as *F* and *H* will be short-circuited on each other in the armature and this cannot be ascertained by testing each coil separately. If the pin points are touched to the commutator brushes and the armature revolved, a decided movement of the pointer will take place when the brushes are on the segments *b* and *c*. The device is easily made and operated, and by its use many an armature will be saved from an untimely end.

Easily Constructed Electrical Conduit and Service Boxes.

By T. C. Lerret.

IT frequently is necessary to meet conditions, in arranging iron-conduit wiring in industrial plants, for which the manufacturers of conduit fittings do not provide appliances. Conduit outlet-boxes are usually procurable only in two sizes, one arranged to take ½-in. and the other ¾-in. conduit. In power, and often in lighting installations, the use of larger conduit is imperative. Fittings can be easily made from rolled-steel plate, or, as it is commonly called, sheet-iron, in a concern's own shop from materials at hand and in a majority of cases at less cost and with less delay than if furnished by a supply house. The reason for this is that, not infrequently, no two fittings on a power job are exactly similar and about as much expenditure would be involved in compiling specifications for what was required as there would be in actually making the fittings. If many of one type are wanted, probably a contractor could furnish them most economically.

Fig. 1 shows some types of boxes that are utilized frequently. All are of the construction herein described and are shown with covers removed. *A* is a pull or splice box which is inserted in a long line of conduit, to provide an opening so that

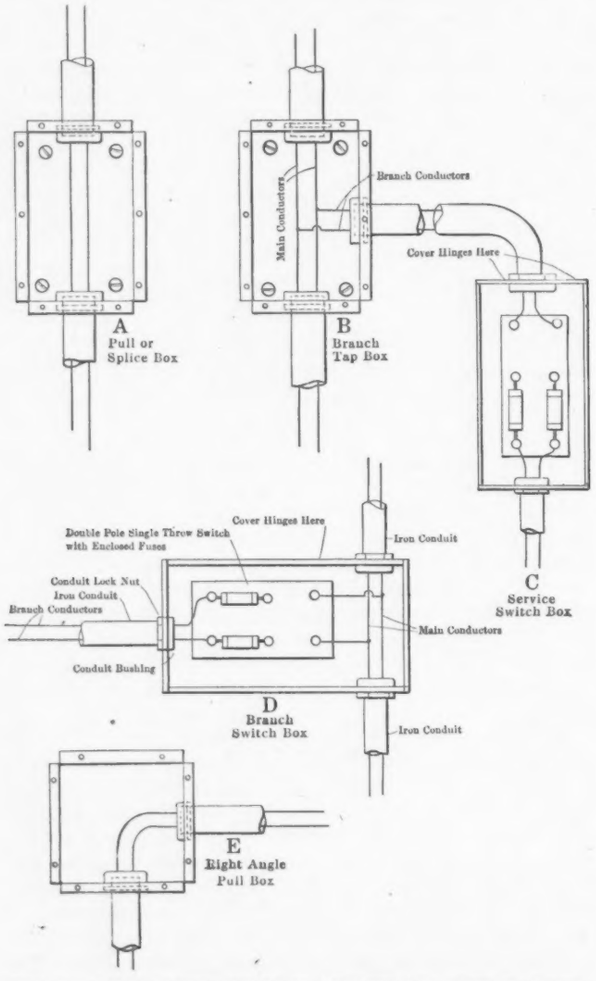


FIG. 1.—SOME USEFUL TYPES OF CONDUIT AND SWITCH BOXES.

conductors may be available for either pulling-in or splicing. The frequency with which pull boxes should be cut-in is determined by the size, consequently weight, of the conductors and by the number of bends in the run. Conditions and experience must decide this question. Pull boxes for ½-in. and ¾-in. conduit can be supplied from stock by any dealer, therefore money would be wasted by a concern making them for itself for these sizes.

A branch tap-box is shown at *B*; it is used at points where it is desired to take branch conductors from a main. Its function is clearly indicated by the illustration. The Underwriters' requirements specify that at each point where the size of con-

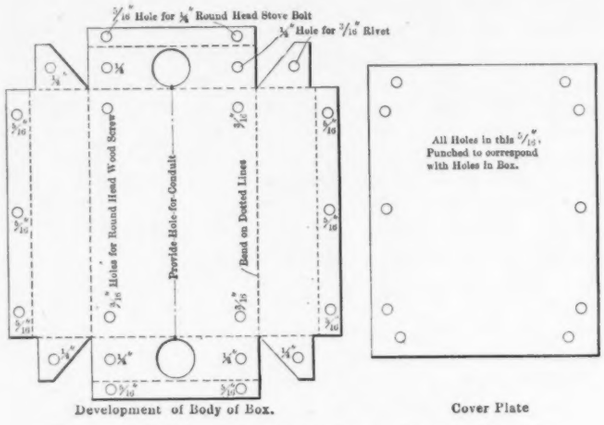

Hole for ¼" Round Head Stove Bolt
Hole for Rivet
Holes for Round Head Wood Screw
Provide Hole for Conduit
Bend on Dotted Lines
All Holes in this Punched to correspond with Holes in Box.
Development of Body of Box.
Cover Plate

FIG. 2.—METHOD OF CUTTING SHEET METAL FOR BOXES.

ductors is decreased, the smaller ones shall be protected by a cut-out (fuse or circuit-breaker), unless the cut-out protecting the main is of such capacity as to protect the branch, the current allowable in each case to be determined by the Underwriters' table of carrying capacity of conductors. To meet this rule it is nearly always necessary either to place a cut-out in the branch box or to use conductors of the same size as the mains until a point is reached where a cut-out may be conveniently inserted. The condition shown in the figure (Fig. 1, *B* and *C*) often obtains. As an example: Electricity is to be supplied for a traveling hoist installed a short distance from the run of the main. In such a case it is desirable to carry branch conduc-

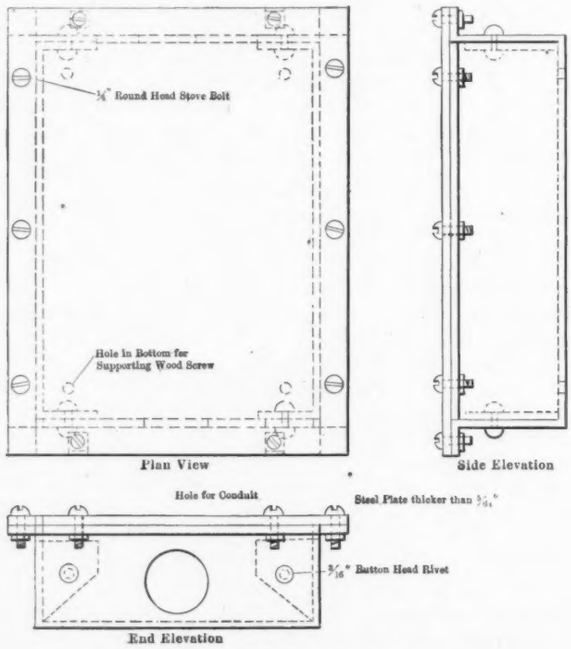


FIG. 3.—COMPLETED SHEET STEEL PULL BOX.

tors of the size of the main conductors to the point where the service switch for the hoist is to be placed and have the fuses in the same iron box with the switch, rather than have the fuses at one point and the service switch at another. This is advisable, of course, only when the distance between the run of the main and the switch box is short. If the distance were great

the increased cost of larger branch conductors might offset the desirability of having the fuses and switch in the same box.

C shows a service-switch box arranged to contain a double-pole, single-throw switch and enclosed fuses. This type of box is regularly manufactured for certain sizes of conduit, and whether it would be best to make them or not must be decided

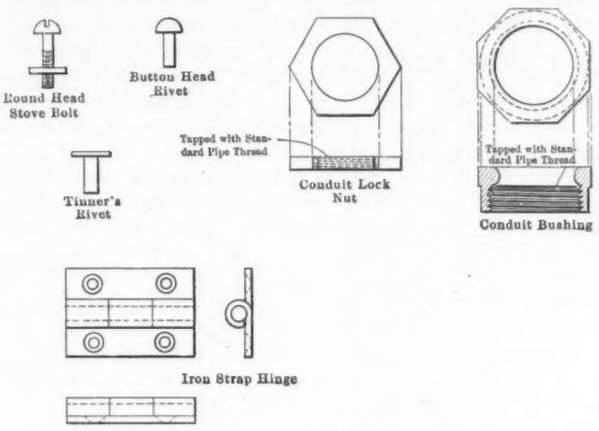


FIG. 4.—SUNDRIES REQUIRED FOR SHEET STEEL BOX CONSTRUCTION.

for each particular case. The branch-switch box shown at *D* is not regularly manufactured and is frequently useful. The illustration clearly shows its application.

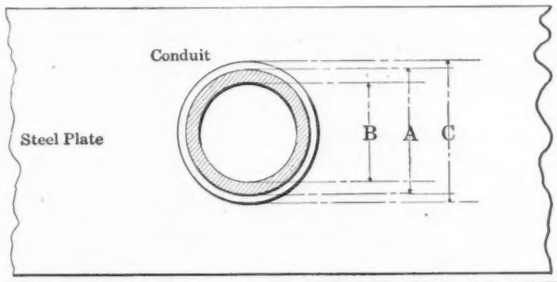
Pull boxes may be developed in a variety of forms. The one shown at *E* is fitted into a conduit run at a right-angle turn in order that conductors may be easily pulled into the conduit. All of the boxes shown in Fig. 1 are constructed from sheet-iron, the same general procedure being followed in each case. The method shown by Figs. 2 and 3 consists in cutting a piece of sheet-iron to the proper form, punching bolt and rivet holes in it, bending it into shape and then riveting the corner flaps. A sheet-iron cover must be provided also. Fig. 2 shows the pattern or development to which a piece of sheet metal must be cut to bend up into the completed box shown in Fig. 3. The cover plate is also illustrated. No dimensions are given on the illustrations as these are determined by the conditions in each particular case. After catching the idea one can easily lay out his own pattern to meet his own conditions by following the scheme laid out in the sketches. It is best first to lay out on paper a pattern for a box, full size, and allow the mechanic making the box to work from the paper sketch. All rivet and bolt holes should be accurately located and dimensioned on the paper sketch, so as to provide a check against error. The paper drawing may be cut out and folded into the form that the completed metal box should assume.

The only material required for the actual construction and installation of such boxes besides rolled sheet-plate is shown in Fig. 4. All of them are readily obtained commercially. It is specified in the Code that sheet-steel composing the walls of boxes must not be less than .081-in. thick (No. 12 B. & S. gage). This is slightly more than 5/64 of an inch, so that any plate thicker than 5/64 of an inch may be used. If, however, the plate be too thick, punching will be difficult. The minimum thickness is quite heavy enough for all ordinary work. To meet Code rules, boxes must also be well painted or enameled to prevent rusting—or they may be made from galvanized plate.

Stove bolts, shown in Fig. 4, procurable about any plant, are used to hold the cover plates to the box bodies. It is not wise to use a bolt smaller than ¼-in. diameter, as smaller ones can readily be twisted asunder with a screwdriver in the hands of an able-bodied wireman. Bolts ¼-in. x ½-in. will work in most readily, but almost any size on hand can be utilized. All holes should be punched 1/16 in. larger in diameter than the diameter of the bolt that they are to accommodate to insure easy fitting and to provide for slight inaccuracies in measurement. Button-head black iron rivets (Fig. 4) make a neat job, but flat-head tinners' rivets—which are of iron, usually tinned—can be used in case the button-head variety is not obtainable.

Rivets 3/16-in. diameter and ½-in. long will be found to be about right for box construction, but if very heavy plate is used the rivets must be longer. Holes must be provided in all boxes through which the iron conduit can enter. The table in Fig. 5 indicates the proper size of hole to provide for each size of conduit. A sufficient working clearance has been allowed in compiling the table. Conduits are held in position in the boxes by lock nuts and conduit bushings (see Figs. 1 and 4). The bushing screws over the pipe, inside the box, and the rounded surface of its unthreaded orifice prevents abrasion of conductors by rough fins on the end of the conduit. A lock-nut threading on the conduit is set up snugly against the outside of the box for obvious reasons.

A switch or service box may be constructed as indicated in Fig. 6. The construction is essentially the same as that of the



Nominal Side Conduit	A External Diam.	B Internal Diam.	C Diam. of Hole to Provide
½"	.840"	.623"	29/64"
¾"	1.050"	.824"	1 1/8"
1"	1.315"	1.048"	1 3/8"
1¼"	1.660"	1.380"	1 25/32"
1½"	1.900"	1.611"	2 1/32"
2"	2.375"	2.067"	2½"
2½"	2.875"	2.468"	3"
3"	3.500"	3.061"	3 5/8"
3½"	4.00"	3.548"	4 1/8"

FIG. 5.—CONDUIT SIZES AND DRILLINGS.

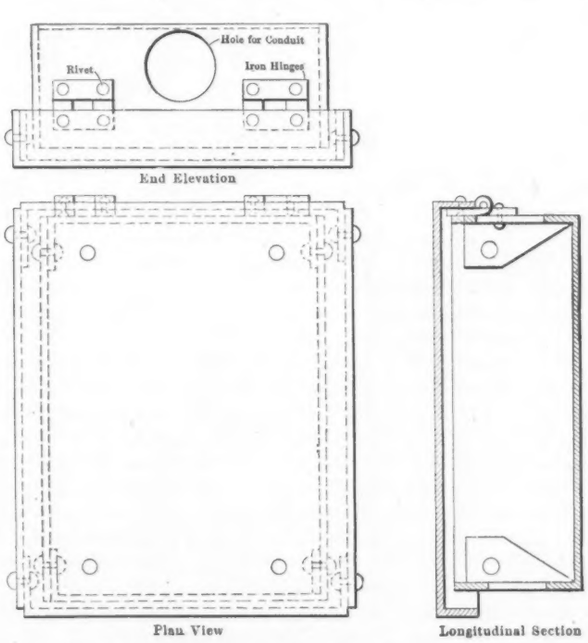


FIG. 6.—DETAILS OF SWITCH OR SERVICE BOX.

pull box shown in Figs. 2 and 3. The flanges which are necessary in the pull box for securing the cover are omitted and a tray-like hinged cover is substituted for the cover plate. Common iron hinges, such as shown in Fig. 4, are riveted to the cover and body, as shown in Fig. 6. The inside of the cover should be at least ¼ in. larger all around than the outside of the box body, to give reasonable clearance. It is more trouble than it is worth to try to make a box of this type dustproof and a failure would probably be the consequence of such an attempt. The cover is intended to provide mechanical protection only. Switch boxes, as a general rule, must be deeper than pull boxes to accommodate the switch. The slate switch base can be secured to the box body by stove bolts. Additional holes should be provided in the bottoms of all boxes through which wood screws or bolts may pass to secure the box to the surface that supports it.

In the event that it is undesirable for an individual to do the actual work in constructing the described appliances, it will be found that the average tinsmith is capable of turning out a very acceptable product if a few directions are given him.

Methods of Making Ground Connections.

The following recommendations on the subject of ground connections are included in the report of the committee on grounding of secondaries of the National Electric Light Association, presented at the recent Chicago convention:

The ground connection may be made on each building service, on the transformer or on a common neutral or ground connecting a number of transformers, or at the central station, or at substations.

All ground wires must be of copper, and must be kept out of the building as far as practicable (except in the case of the central station or substation), but any ground wire which is inside of any building or attached to any building or pole must have rubber insulating covering, approved in National Electrical Code for from 0 to 600 volts. No wire smaller than No. 4 shall be used for ground connections.

Ground wires may be attached to poles or buildings by porcelain cleats or knobs. Staples must not be used. The wire must be run in as nearly a straight line as practicable, and where exposed to mechanical injury must be protected by a wooden molding or by an iron pipe, which latter does not require grounding when it contains the ground wire only.

Ground connections for transformers in central and substations, for transformers in banks or connected by common neutrals or grounds, and for individual transformers, must be made to all available underground water or other subsurface piping systems (except that gas-piping systems must not be used), or to a grounded railway return system, or to a metal plate buried in coke below permanent moisture level, or to pipes driven into permanently damp soil. Additional grounds may be connected, but they are not required.

When each building service is grounded, ground connections on transformers are not required. This ground on the service wire must be made on the transformer side of the main switch and cut-out, and the wire should, as far as practicable, be kept out of the building, but should be run into the cellar and connected to the water-piping system, on the street side of water meters and main cock. When the ground wire is run through any part of the building it shall be upon porcelain knobs, in molding or in conduit. Where water pipes are not available, a metal plate or driven pipe shall be used.

Connection to water piping and to driven pipe shall be made through an approved ground-connecting clamp after all rust and scale have been removed, or by soldering into a brass plug which has been screwed into a pipe fitting, or where the pipes are cast iron, into the pipe itself.

Connection to a grounded railway return shall be made by means of a bolt or rivet passing through a rail, holding the wire mechanically tight, after which the rail, bolt and wire shall be carefully soldered together and the joint painted with waterproof paint or equivalent. When a railway return circuit is used for a ground connection to a transformer, or to a bank of transformers where the secondaries are interconnected, or to a secondary main, the use of more than one ground is prohibited.

When a ground plate is used it shall consist of a No. 16 Stubb's gage copper plate with an area (one side) of never less than 10 square feet, and must be increased proportionately when the capacity of the generator or transformer to which it is directly connected exceeds 500 amp; about 2 ft. of crushed coke or charcoal about pea size shall be placed both under and over it; or in place of copper a cast-iron plate of approximately the same area and at least ½ in. thick may be used. The joint between the plate and the ground wire should in all cases be soldered and thoroughly protected against corrosion by waterproof paint or some equivalent.

When driven pipes are used they shall be of iron and not less than 1 in. in diameter, preferably larger. When used for the ground connections of central and substations, and for a number of transformers, the area of the driven portion of the pipe must never be less than 20 square feet and must be increased proportionately when the capacity of the generator or transformer to which it is directly connected exceeds 500 amp.

When used for the ground connection of individual services or for single transformers, the conductivity of the ground must be tested by blowing a 2-amp fuse at 110 volts, and the number, size or length of pipes increased until this occurs, when connection is made between the ground and a neighboring ground of any kind; or this test may be made by blowing the primary fuse in the transformer at the primary voltage.

In central and substations and transformer installations of large size, it is recommended that more than one ground wire be used, and that if ground plates or driven pipes are depended upon, the area be materially increased.

The requirement of 20 sq. ft. of surface area for a pipe ground appears impracticable under ordinary circumstances, as it calls for a length of 58 ft. of 1-in., 40 ft. of 1½-in., or 32 ft. of 2-in. pipe.

Electrically Operated Switchboard—III.

By S. Q. Hayes.

ELECTRICALLY-OPERATED CARBON CIRCUIT-BREAKERS.

In a power plant where generators, transformers and alternating-current feeder circuits are controlled by electrically-operated oil circuit-breakers, it is sometimes desirable to extend the electrical operation to the exciter circuits and to provide solenoid-operated carbon circuit-breakers for their control. Fig. 1 shows two 800-ampere, 250-volt, three-pole, carbon circuit-breakers for this class of service. These circuit-breakers are provided with signal switches to operate indicating lamps on the switchboard.

For large rotary-converters or direct-current generators, it is

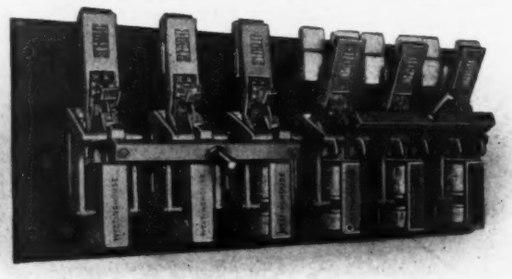


FIG. 1.—THREE-POLE CIRCUIT-BREAKERS.

sometimes advisable to install electrically-operated, carbon circuit-breakers. Fig. 2 shows a 4000-ampere, 750-volt, single-pole circuit-breaker with solenoid operation and signal switch. The general design of the circuit-breaker, which is a modification of a hand-operated circuit-breaker that has been on the market for many years, is clearly shown in the engraving.

These carbon circuit-breakers can, of course, be used on

low-voltage, alternating-current circuits of large output, and these, as well as the oil circuit-breakers, can be provided with suitable relays to meet overload, underload, no voltage, reverse power or other conditions, and such relays can have instantaneous release, definite time limit, inverse time limit or other desired features.

While different engineers have their own ideas regarding automatic or non-automatic circuit-breakers for various circuits, the following practice is nearly standard:

No fuses or other automatic protection are provided for exciter circuits, as the sudden opening of the field coil circuit of an alternator due to the blowing of a fuse in the exciter circuit or the tripping of an exciter circuit-breaker is apt to injure the insulation of the alternator and cause far greater damage to the plant and involve a larger expense than the overloading or short circuit of an exciter. In a few very large installations with exciters operating in multiple with each other or a storage battery, reverse power circuit-breakers are used to cut out a damaged exciter. Where exciters are used to supply energy both to a field bus and to a direct-current station bus feeding lamps and motors, fuses or circuit-breakers are sometimes supplied to disconnect the exciter from the station bus in case of trouble, while still leaving it connected to the field bus.

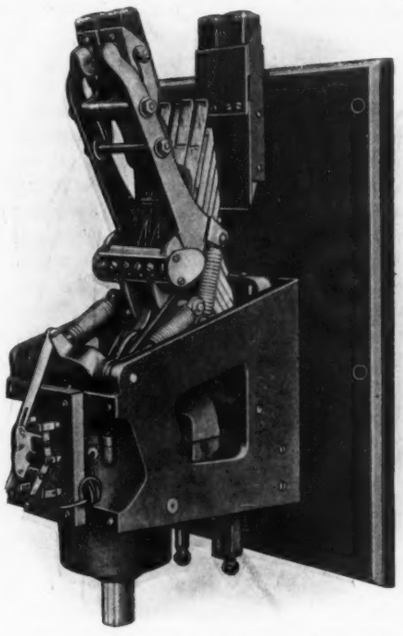


FIG. 2.—SINGLE-POLE CIRCUIT-BREAKER.

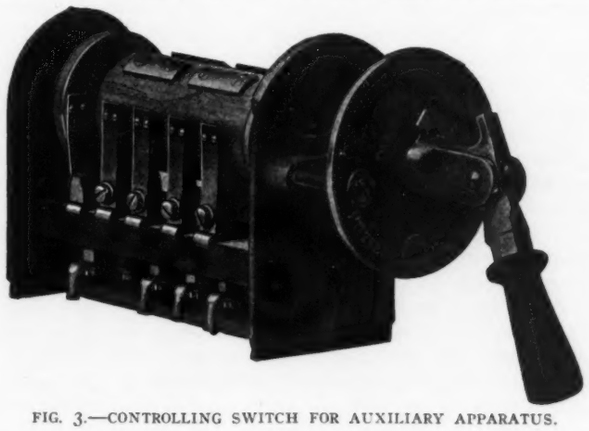


FIG. 3.—CONTROLLING SWITCH FOR AUXILIARY APPARATUS.

As a rule, no automatic protection is supplied either in the field or armature circuits of alternators. The protection is omitted from the field-coil circuits for the same reasons as it is left out of exciter circuits; namely, to prevent the sudden opening of the field-coil circuit by the blowing of a fuse or the tripping of a circuit-breaker. The protection is omitted from the armature circuit of alternators for the reason that most modern machines have sufficient armature reaction to enable them to stand a temporary short-circuit without damage, and for this reason protection is not necessary. Such protection is, moreover, considered a positive disadvantage when synchronizing, for if two machines are thrown together somewhat out of step there will be a passage of energy from the leading to the lagging machine that will pull them into step without damage; but this, added to that which the loaded machine is already carrying, is very apt to blow fuses or trip circuit-breakers.

In some large plants the generator circuit-breakers are made non-automatic on overload, but provided with a reverse-power relay that will trip the circuit-breaker if the generator should receive energy from the busbar for an appreciable length of time. Occasionally these reverse-power relays instead of tripping the circuit-breaker will light a lamp or operate some other signal device that will call the attention of the station operator to the abnormal condition, and it is left to his judgment to adjust the governor, cut out the generator or take whatever steps may seem necessary.

Feeder circuits, as well as the low-tension side of the step-up transformers or the high-tension side of step-down transformers, are usually provided with automatic circuit-breakers, while tie circuit-breakers and those used for the secondary-side of transformers are normally non-automatic. These latter, however, are sometimes provided with a reverse-power relay or a differential relay that will operate in case of a local short circuit in the transformer to cut off both the high-tension and the low-tension circuit-breakers.

ELECTRICALLY-OPERATED FIELD SWITCHES.

Two-pole solenoid-operated field switches are installed and these are provided with auxiliary contacts for cutting in a discharge resistance just before opening the field circuit. No signal switch is ordinarily provided with the field switch as the field ammeter will show whether the switch is open or closed.

ELECTRICALLY-OPERATED FIELD RHEOSTAT.

Field rheostats may be motor-operated and the face-plate provided with a clutch so that in case of trouble to the motor the face-plate may be operated by hand after disengaging the clutch. With this face-plate, a signal switch is provided to actuate a lamp on the switchboard when the arm is bridging two contacts. This face-plate is also provided with a limit switch that opens the motor circuit when the arm has reached the limit of its travel in either direction and the connections are so made that while the motor can no longer be operated in one direction it can be run in the opposite direction.

AUXILIARY APPARATUS.

For the operation of the various circuit-breakers, field switches, etc., a controlling switch similar to that shown in Fig. 3 is supplied. The operating handle and dial are mounted on the front of the switchboard, while the contacts are placed back of the board and are made part of a drum-type controller. This construction removes even the direct-current operating voltage from the front of the board and readily adapts itself for use on 550-volt control circuits. This particular control switch is intended for use with oil circuit-breakers and the handle is so designed that after turning to the trip position it can be lifted to stand at right angles to the plane of the dial plate when a circuit is to be cut out of service for any length of time. In this position all the indicating lamps are disconnected. For use with this controller an electro-mechanical indicator or lamp indicators with colored prisms are supplied.

For making the connections from the controllers to the circuit-breakers, field switches, field rheostats, etc., and from the instruments and relays to the series and shunt transformers, multiple cable is used and this is ordinarily provided with varicolored braids for the different cables and the assembled cables given a lead or fireproof covering. Such cables are usually installed in conduits, having a nominal diameter of about 1¼ in.

The various other details, such as disconnecting switches, busbars, supports, etc., will be treated in a subsequent article.

The Use of Direct-Current Portable Testing Instruments.

By E. P. Peck.

PORTABLE instruments when used for testing are commonly relied on to give results well within 1 per cent, and many persons rely on them to 1/5 per cent, as some makers guarantee their meters to that accuracy. While there is no doubt that meters come within their guarantee when new and used under the proper conditions, still there are so many conditions that affect the accuracy of results that such accuracy is too much to expect, unless the user knows the causes of error and how to guard against them. Even then, there may be some influence which has been overlooked. When making efficiency tests and meter tests, too much care cannot be exercised to remove all disturbing influences before taking readings.

It has been found that tests made with instruments calibrated specially for the purpose are often so far from what is expected that a re-test is made, though the instruments check O. K. The second test may give proper results when the first was in error several per cent. There is no doubt that if all disturbing influences had been known and provided for that the first test would have been correct. For this reason, no engineer can know too much about portable testing instruments, though their use seems very simple.

The errors in direct-current meters may in general be divided into four classes:

1. Errors in the standards used when calibrating the meter; 2. Inherent defects in the meter, and external influences; 3. Reading errors; 4. Errors due to age or hard usage.

The first class of errors may be kept quite small by using very accurate standards, and spending a large amount of time and work in keeping them up to their highest accuracy and determining any error as soon as it is manifested. In many checks made this is the most important error to be guarded against, for portable instruments are often used as standards for checking other instruments when they have not been checked in months themselves and they may be in error several per cent.

The second class of errors depends primarily on the construction of the individual instrument. These errors vary largely with different instruments, and in a given instrument are different in different portions of the scale, and under different conditions of external influence. Stray magnetic fields have a large effect on unprotected meters of the usual type. We have found errors greater than 5 per cent caused by stray fields in a central station.

These fields are produced by wires carrying current as well as by machinery. When making tests in which large currents are used, the leads to ammeters and wattmeters should be arranged so that they do not influence the readings. Meter testers are often careless in this regard and allow a loop to form in their leads near the meter which may cause large errors in their results.

A meter should never be placed on or near a piece of iron when in use, for the magnetic lines are shunted around the armature and cause the meter to read low. A magnet placed near a meter may cause it to read either high or low, depending on the way it is placed. Therefore, two meters should *never* be placed side by side when in use.

When it is necessary to use a meter where there are external magnetic fields, the average of two readings taken in quick succession with the meter rotated 180 deg. between readings may be used. A position may be found so that the meter reads the same when reversed; in this case it is not necessary to change the meter.

Some types of meters are free from errors due to stray magnetic fields, and any meter is practically free from them if in an iron case. Therefore, switchboard meters as generally built are not appreciably affected.

Changes in temperature cause several different effects in meters. A voltmeter is only slightly affected by changes in temperature, for almost the whole resistance of the meter is made of wire in which the temperature co-efficient is negligible, and the resistance of the copper moving coil is so small that a change of 5 per cent in its resistance is an extremely small per cent of the total meter resistance. There is no appreciable heating due to the energy used in the meter, as it is usually not over 1.5 watts in a 150-volt meter, and the radiating surface is so great that the temperature rise is not noticeable. On account of the very small current used, voltmeters are not liable to errors due to the springs being annealed.

Self-contained ammeters—that is, ammeters in which the shunt is made in the meter case—are free from errors due to changes in room temperature, provided the meter has had time to assume the same temperature throughout its whole mass. The moving coil, adjusting resistance, and shunt, in this type of meter, are usually made of copper, and an equal change in temperature produces the same proportional change in resistance in each part of the circuit, causing the proportion of the current taken by the meter element to be the same.

On account of all the conductors in the meter being copper, thermo-electric currents do not usually cause a noticeable error unless one of the current-carrying leads makes very poor contact with one binding post. This will cause one post to heat more than the rest of the meter, and set up thermo-electric currents which may cause a very appreciable error in a meter for medium currents.

Self-contained meters of a size much over 50 amperes are accurate only when in the circuit a very few minutes. In the case of a 150-ampere ammeter, the error became 3.5 per cent in 30 minutes, the meter reading high. This is due to the copper shunt heating under load, to a higher temperature than the moving coil, and the increased resistance due to this heat caused a greater voltage drop across the meter element. It is very often that a meter of this size or even larger is put in circuit and readings taken for several hours, when the meter after the first 5 or 10 minutes has greatly exceeded the allowable error for close work. In case it is necessary to use a meter this way, it should be short-circuited by a switch, which should be open only when actually taking readings.

A millivoltmeter and shunt may be made practically free from errors due to heating by the current to be measured, for the shunt is made of a metal of low-temperature co-efficient, and the current carried by the meter is so small that it does not heat appreciably. In this class of meter the adjusting resistance in series with the moving coil has also a low-temperature co-efficient, and as a large part of the drop across the shunt is used in this resistance, a change in temperature of the whole meter does not affect the accuracy of the results nearly as much as it would if the resistance was of copper.

When using the millivoltmeter and shunt there are, however, two classes of errors to be looked for. One class is of errors due to bad contact of the millivoltmeter leads, and the other, bad contact of the main current-carrying leads. The first will cause the meter to read low. The second will give rise to thermo-electric currents which may cause the meter to read either low or high. In one case where one side of the shunt was noticeably warmer than the other, an error of 4 per cent was caused in this way. The results may be corrected for this error, as the reading of the meter immediately after the current is cut off gives the correction to be made. The only difficulty is to determine where the corrections should begin. It is manifestly unfair to correct the whole of a long series of readings for an error which was zero at first and rose gradually to a maximum, at which it remained. Therefore it is best to guard against this error by using leads of ample size and making good contacts.

The error due to stray fields should be specially guarded against when using the millivoltmeter and shunt, for these meters are used entirely for very heavy currents and chances of error are large.

A static charge on the glass, generated by rubbing to remove dust will cause the needle to deflect several divisions on many meters. So a meter should not be read immediately after rub-

bing unless the charge be removed, as may be done by touching the glass with the finger.

The third class of errors is kept small by using the greatest possible care in all readings that are taken. This applies to commercial work as well as the laboratory calibration of the instrument.

Some makers guarantee their meters to 1/5 per cent. If this was changed to 1/5 of a small division it would be better, for the meter is correct to 1/5 per cent of the actual reading only when used at or above 100 divisions. This may easily be seen, for a meter can hardly be read closer than 1/10 of a small division. Therefore when reading on the first long division, or reading 10 amperes on a 100-ampere meter, an error of 1 per cent cannot be detected. The Westinghouse Electric Company publishes a formula for its meters which shows the maximum error in any part of the scale. This takes into consideration the errors of standards used in checking the meter and the possible errors due to friction and in reading. Making the constants in this formula apply to the meters under discussion, it is $\frac{.1R+.1r}{r}$ = per cent accuracy, in which R is the full scale reading of the meter and r is the actual reading.

The first constant is taken as .1 because the reading and friction errors cannot be taken as less than that. The second constant is taken at .1 because the errors in standards and in readings due to variations in the current when checking make a smaller constant than this inadmissible unless more than ordinary care is used. Working this out for a meter with 150-scale divisions, it is seen that the probable errors in using a meter are as follows:

Divisions	150	100	50	10	5
Per cent, error	.2	.25	.4	1.6	3.1

From this it is seen that a meter should not be used below ⅓ of its scale, if an accuracy of over .4 per cent is expected. This class of error should be kept in mind when buying meters for a known service.

The effects of age and hard usage are shown in worn or broken jewels and pivots. If jewels are not perfect the meter will stick in any part of the scale, and will not indicate correctly. Slight tapping will improve the accuracy of the reading somewhat, as the jar enables the movement to reach its true position. This should not become a habit, however, for it is very hard on a good jewel and pivot. With some men the habit is so developed that they will tap a meter even when the pointer is moving smoothly and evenly, and indicating every change in voltage, even the pulsations due to the engine. The same men have been known to knock a moving element entirely out of its jewels in order to make it read when the current was too low to show on the meter.

Long use will often cause parts of the meter to work slightly loose and make small particles of dust and magnetic material to become loosened and block the delicate moving system. A blow or a strain of the metal case covering the instrument will prevent its fitting perfectly to the wooden base of the instrument. This allows small particles of dirt to enter the meter where they soon find their way into the very dense magnetic field in which the moving element works and causes the meter to stick.

A very severe blow may partly demagnetize the permanent magnets and cause the meter to read low. It is possible also for the magnets to be demagnetized by very strong fields due to alternating currents. A voltmeter which was placed near the alternating-current mains of a rotary converter was found to read 350 volts on a 600-volt circuit after a severe short circuit on the rotary. The meter was within 18 in. of the busbars and the alternating currents, probably several thousand amperes for an instant, demagnetized the magnets.

An overload, if severe, will bend the needle. This may be straightened and the meter put into as good shape as before—apparently. One change often takes place which cannot be seen, however. The springs which carry the current into the moving coil have become overheated and annealed. This will cause the meter to read high and may change the proportionality of the scale also. A meter should always be calibrated after being "knocked out."

It is hardly probable that all of the errors mentioned will exist in any one meter, and those present may group themselves so as to make the actual error much less than the sum of all errors would indicate. In most cases all of the errors together are not enough to affect the results excessively, but it is only by the exercise of great care that results may be *always* relied upon.

It must be understood that every part of this discussion does not apply to all classes of meters; but unless the characteristics of the meter used are well known it is best to eliminate the possibility of trouble.

Locating Grounds in Armature Coils.

BY W. M. HOLLIS.

When, in making the usual routine tests of machines for grounds, the armature is found to be grounded, some difficulty may be experienced in locating the precise coil or coils thus affected. Preliminary tests are usually made with a voltmeter by obtaining the voltage across the mains and then the voltage when the voltmeter is connected across the mains and in series with the resistance between the armature wires and the armature core. If V is the voltage on the mains and V^1 is the voltage reading in the second instance; R being the voltmeter resistance and r the insulation resistance, then $r=(V\div V^1)\times R$ very nearly. However, the purpose of the test is merely to locate the ground if the insulation is low. If a bad ground exists and there is also a ground on the other side of the

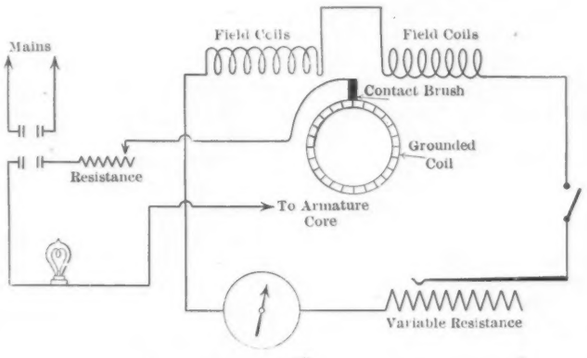


FIG. 1.—CONNECTIONS FOR LOCATING GROUNDED COIL.

circuit the armature ground will probably manifest itself in the smoking or burning armature coil at the point where it is grounded on the core.

If the point grounded cannot be discovered by inspection other means must be employed. One way is to wind a bare copper wire several times around the armature for an open coil armature as, for instance, with some kinds of arc light dynamos, or for an ordinary closed coil armature to use a single brush. One side of the testing main is connected to the brush through a resistance so as to limit the current and the other side of the main is connected to the core through a limiting resistance. The limiting resistances are used, at first, to prevent possible short circuits. In some cases where there are more than one form-wound coil in each slot, or where there are a number of layers of wires in the slots or on the armature core proper, there may be difficulty in finding which coil or turn of wire is grounded without removing the coils one at a time from the commutator segments.

A lamp bank may be used as a suitable limiting resistance, one line wire being connected to the commutator through the lamp bank and the other connected to the armature core. Then if the switches be closed and the resistance decreased, the fault may show up through a burning or smoking of the insulation at the point grounded. Care should, of course, be exercised

not to use a greater voltage than necessary to show up the ground, so that unnecessary charring or burning of adjacent coils not grounded may be avoided. If a coil is badly grounded it will have to be replaced, and if there is no damage to adjacent coils the replacing of one coil is not very difficult. No definite statement can, however, be made to apply to all cases, as there are so many different forms of armature windings from the larger machines having two insulated formed coils in each slot where one coil may be replaced without disturbing many of the others, to some of the smaller machines where several coils or many turns are placed in a slot and where a grounded or burned-out coil may make it necessary to take out and replace many of the armature coils. Beyond outlining the method of testing in a general way, the winding will vary considerably in amount for different machines.

If lamps are used as a series resistance and two 110-volt lamps are used in multiple for each 100 volts of the testing voltage to start with, the maximum current possible would be one ampere even with a completely grounded coil, each lamp alone consuming approximately one-half ampere on 100 volts.

FIG. 2.—APPLICATION OF EXPLORING BRUSH.

Then with these pairs of lamps in series the voltage between the armature coil and the core may be increased in steps of 100 volts by using a proper switching device or by short-circuiting the pairs of lamps until the grounded coil smokes or burns.

Where the tests show that there is a definite ground between the armature coils and the core and where the fault cannot be located by using the testing voltages at hand, another method for finding the defective coil without removing all the leads from the commutator may be used. Where one has the facilities of a laboratory at hand or a sensitive galvanometer, the defective coil may be located with certainty. In place of this, however, satisfactory results can be obtained by using a modified millivoltmeter or a sensitive instrument made from a compass or magnetized needle or small light pieces of steel suitably mounted and surrounded or placed close to a coil having many turns of fine wire. Referring to Fig. 1 the grounded coil is attached to the commutator segment indicated. A contact brush adapted to be moved around the commutator so as to make contact with the segments one after the other is also shown. The galvanometer is shown connected across the field coils in series with a variable resistance and switch. One line is connected from the mains to the armature core through a lamp and the other line is connected to the contact brush through a variable resistance. In starting the test, a high resistance should be connected in both circuits, as the test is a somewhat delicate one and the galvanometer in order to operate correctly must be very sensitive. Referring to the illustration the circuit from the testing mains is made through the contact brush to the commutating segment, thence through the armature coils, one after the other, until the grounded one is reached, when the current passes to the armature core, and thence to the other side of the testing mains. Inasmuch as the galvanometer is in a circuit which includes the field coils of the machine, and there is an inductive relation between the two circuits, if the armature circuit is opened and closed by means of a switch, the current in these coils sets up a magnetic flux in the armature core which then acts upon and sets up a flux in or magnetizes the field cores and this flux in turn sets up an electromotive force in the field coils which sends a current through the indicating instrument. The action is somewhat similar to that between the primary and secondary coils of a transformer and the quicker the make or break of the armature circuit is made the greater will be the effect upon the indicator. The contact breaker may be made to touch the commutator segments one after the other by moving the armature, and the number of armature coils in series between the brush and the grounded coil decreases until the brush rests upon the commutator segment connected to the grounded coil, when there will be no turns in series or at least a minimum number of turns depending upon the armature turns connected to each commutator segment.

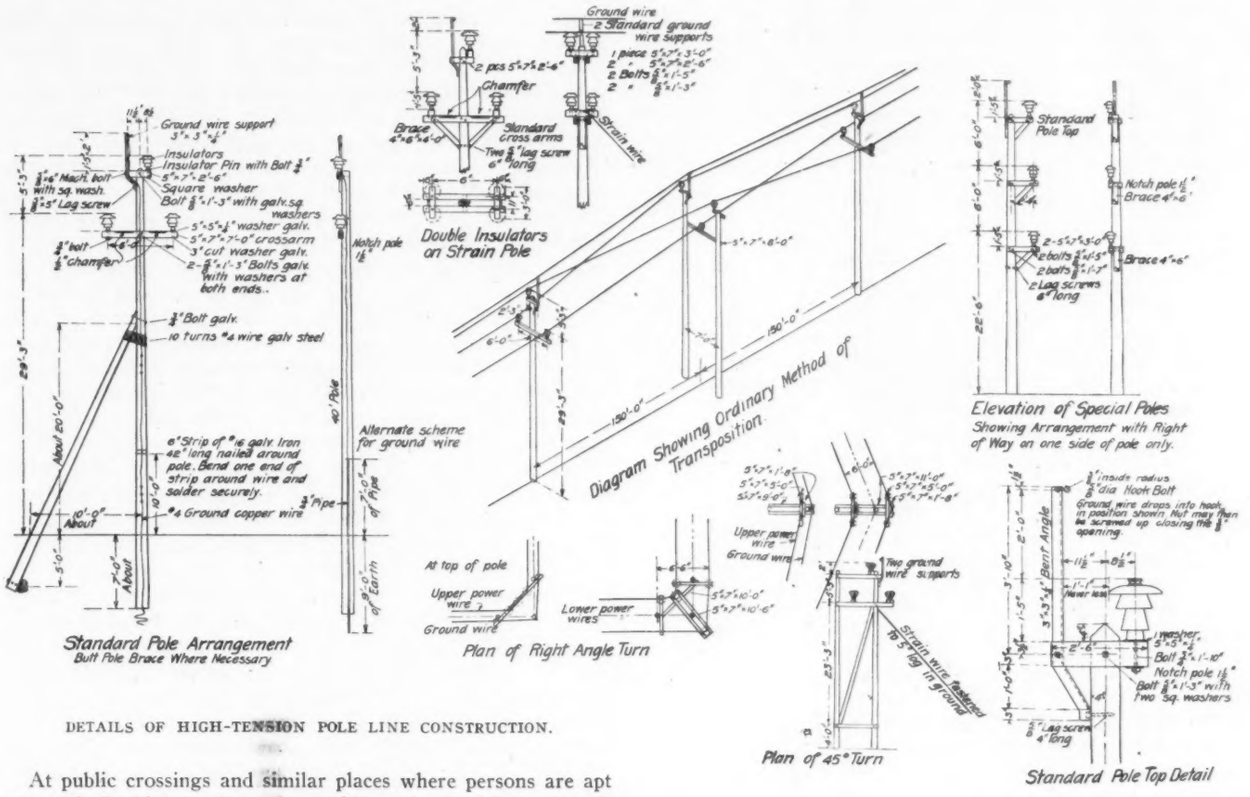
The switch should be opened and closed and the throw of the galvanometer noted each time the contact brush is changed to another segment until a minimum deflection is indicated. The defective or grounded coil is the one upon which the contact coil rests when there is a minimum deflection when the testing circuit is opened and closed suddenly. Fig. 2 shows the position of the contact brush C when there will be the large deflection of the galvanometer needle, as there are many armature turns in series between it and the grounded coil. C' shows the position of the brush when there will be a minimum throw of the galvanometer needle and when the brush is in contact with the commutator segment connected to the grounded armature coil. These tests should, of course, be carefully made at first, because the kick or induced voltage in the field will vary widely for different types of machines, with the current used in the armature coils, and with the position of the contact brush with reference to the grounded coil. It is best to start with a very low and steady current through the circuit containing the armature coils and to use a spark gap between needle points in the field circuit, in order to determine whether the voltage induced is likely to be very high. With a gap one-quarter of an inch between needle points a voltage of 5000 or more will jump across the points. After this precaution has been taken to avoid any chance of injury to the galvanometer a high reading voltmeter may be tried, and the armature current or voltage adjusted until a suitable deflection is obtained. If there is a complete ground, the circuit could probably be adjusted so that an ordinary voltmeter may be used; but if the insulation resistance is very low a millivoltmeter or a galvanometer may be required, with the proper arrangement of series resistances or shunts ordinarily used for safe-guarding them.

High-Tension Transmission Line Construction.

The Buffalo, Lockport & Rochester Railway Company's line between Buffalo and Rochester, N. Y., which is now nearing completion embodies in its construction some interesting high-tension transmission line work. The company will use energy from Niagara Falls over the lines of the Niagara, Lockport & Ontario Power Company. The 60,000-volt, three-phase, 25-cycle lines of the latter company will be tapped at Lockport and at South Greece. The substation at South Greece is already connected by a 3-mile run to the transmission company's lines and the railway company has erected a wooden pole line 60 miles long between South Greece and Lockport. This pole line is on private right of way with detours to all villages along the route and presents several interesting features. There are five substations along the route, situated at Gasport, Medina, Albion, Brockport and at South Greece. The substations are all of uniform design and size and will each house ultimately three 400-kw synchronous converters with the usual transformer and switching equipment.

Standard 40-ft. poles are used and the high-tension wires are carried on four-part insulators tested to withstand a tension of 150,000 volts for five minutes. The insulators are mounted on iron pins and have a separable thimble cemented into them for convenience in removing the insulator from the pin if necessary. The insulators for the lower wires are mounted as shown in the engraving on standard 7-ft. cross-arms and are spaced 6-ft. centers; the upper insulator is placed on a 2-ft. cross-arm, to which is also attached the ground wire support. Most of the cross-arms are void of braces, the lower arm being secured to the pole by two $\frac{5}{8}$-in. through bolts and the upper arm by a single $\frac{5}{8}$-in. bolt and the lower portion of the bent angle iron support for the aerial grounding wire. The latter is of tough phono-electric material and is grounded at every fourth pole.

The grounding wire is carried about 20 in. to one side of the upper high-tension wire and 2 ft. above it, as shown in the detail drawing of this portion of the pole.


Standard Pole Arrangement
Butt Pole Brace Where Necessary
Double Insulators on Strain Pole
Diagram Showing Ordinary Method of Transposition
Plan of Right Angle Turn
Plan of 45° Turn
Elevation of Special Poles
Showing Arrangement with Right of Way on one side of pole only.
Standard Pole Top Detail

DETAILS OF HIGH-TENSION POLE LINE CONSTRUCTION.

At public crossings and similar places where persons are apt to touch the high-tension poles, a 6-in. galvanized iron grounding strip is placed on the pole about 10 ft. above the ground. This trip is wound around the pole and also soldered to the ground wire, so that for a distance of 10 ft. above the ground a person touching the pole, even though the conditions were such that leakage was excessive, would be immune from shock. Where necessary butt-bracing is adopted in preference to guying.

Where detours had to be made around towns along the border of one property over which right of way was secured, a novel variation in the pole line construction was required in order to avoid trespass on adjoining property. In this case each high-tension wire is carried on one side of the pole on separate wooden cross-arms, while the grounding wire is carried on a straight angle iron support screwed to one side of the pole. To avoid disturbing the telephone circuits on the opposite pole line the high-tension wires are transposed between each substation and the telephone wires are transposed every fourth pole, or every 440 ft. The method of making the high-tension transposition is clearly shown in the engraving. The method of making right-angle turns and 45-deg. turns is shown also.

Automatic Damper Regulators - II.

By W. H. Wakeman.

In a previous article dealing with this subject, a number of regulators were described. All of them except one were operated by steam pressure, and in the one either steam or water was applicable. Fig 1 illustrates a regulator that is operated by water pressure alone, although the steam pressure indicates the time when changes in its position shall take place. Boiler pressure is available in the pipe 2, but it is arranged so that it is always full of cold water, as heat is not wanted here. This pressure is always acting on the diaphragm 3, but so long as it is less than the maximum desired, the lever 4 remains in its lowest position.

The maximum working pressure is determined by the number of weights on the end of this lever, and the position of the smaller weight on it. As the boiler pressure approaches the limit it acts on the diaphragm 3 and raises the lever 4, opening the pilot valve 5. This action admits water under pressure through the pipe 6, the sediment chamber 7 and the connecting pipe to 5, and thence through another pipe to the

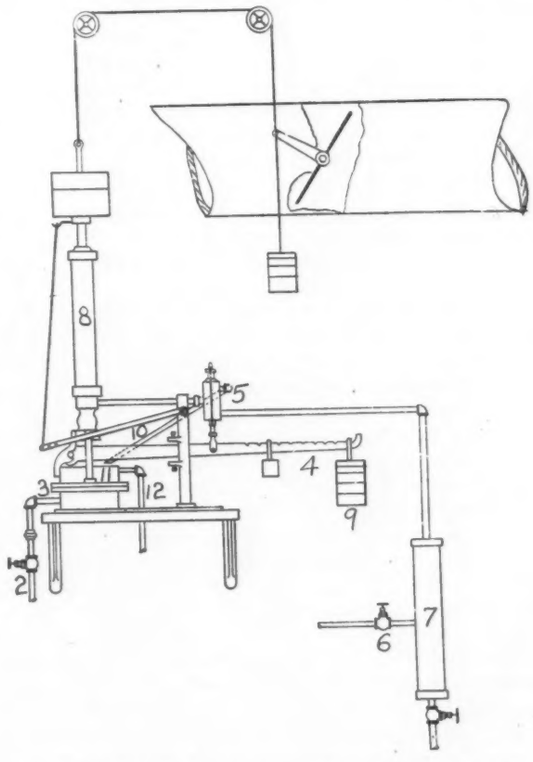


FIG. 1.—HYDRAULICALLY-OPERATED DAMPER REGULATOR.

cylinder 8, in which is a leather-packed piston. Water pressure forces this piston upward and allows a weight on the lever

to close the damper. When the pressure falls about 1 lb. the weights 9 force the lever 4 downward. This action closes the pilot valve 5, opens another passage to the waste pipe 10, releasing water from the cylinder 8 and allowing it to flow into 11, and thence through 12 to the sewer. As there is nothing to support the piston in the cylinder, the weights above it (also its own weight), force it downward and open the damper through the connections shown.

The stroke of the piston in 8 is more than 12 in. long, and as the water flows into it through a small pipe it closes the damper slowly. If the fire is in good order and the load is

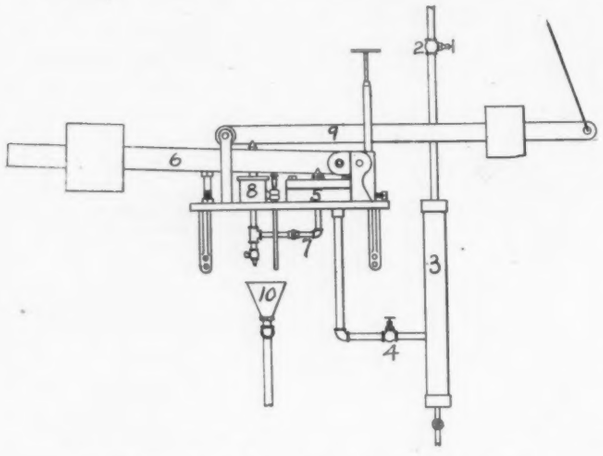


FIG. 2.—REGULATOR WITH COMPOUND LEVER DEVICE.

about equal to the capacity of the boiler, the piston may go up perhaps one-half of its stroke, then as the fire is checked, the pressure falls 1 lb. and this causes the piston to reverse its motion and open the damper. On the other hand, pressure may be high enough to close the damper until it falls 1 lb., then the piston begins to move downward, but before its stroke is completed the pressure may rise 1 lb. and result in closing the damper again.

This plan of operation is favored by engineers who are contented with a slow fire, provided it maintains the required boiler pressure, and it certainly is a very pleasing movement. As a general rule, this regulator will open a damper wide and then close it tight before its motion is reversed, but even then it is a comparatively slow process.

One of these regulators has been in use for nearly 14 years without repairs except a new leather packing for the piston once in two or three years, costing only a few cents. It operates two large dampers for two batteries of boilers, and this calls attention to the fact that two regulators might have been installed, one for each battery, but the objection to this plan is as follows: The difficulty of adjusting two regulators to operate exactly alike and the improbability of their remaining alike in every-day practice will be apparent to all practical men; therefore when steam pressure is below the limit both will be open, but when the maximum is secured, one will close and shut off the draft from one battery, while the others remain open and causes that battery to do all of the work. The same principle causes one to open in advance of the other and force the fires to which it is connected, while the others remain dormant. Where both dampers are connected to one regulator the draft remains the same on all of them at all times so far as the dampers are concerned.

It frequently happens that one fire is in better condition than the others, hence those that need building-up ought to have more draft on than those which are clean and well ignited. On this account the idea of providing a regulator for each boiler has been advanced; but while it may not be impossible to do this, it is not practicable, because all are connected to the same steam main, hence the pressure in them will not vary with the condition of the fires. When a practical way of regulating the draft for each boiler of a battery according to the condition of the fire is found, it will be a good idea to provide a regulator for each boiler. There should always be a hand-operated damper for every boiler, thus enabling the fireman to shut off one whenever it is required.

Fig. 2 is a regulator that is fitted with a compound lever device, which is an interesting feature. Steam is admitted by the valve 2 to the condensing chamber 3, for only water under boiler pressure is wanted to operate the regulator. If it is more convenient to make a connection into the boiler at a point below the water line, the regulator will work just as well and there will be less heat to dispose of than where steam must be condensed. Pressure is communicated from 3 through 4 to the diaphragm 5. As the limit of pressure is secured, the lever 6 rises and opens a valve that admits pressure from 5 through 7 to 8 and this raises the lever 9, closing the damper until pressure falls about 1 lb., when the process is reversed so far as the levers are concerned, and the damper opens. The water used is discharged into the funnel 10 and carried to the sewer. Where it is desired to be very economical in the use of water, it can be saved and pumped into the boiler again, but the amount is so small in a case like this that it does not pay to save it.

Fig. 3 illustrates a very good regulator attached to a damper in regular service. Boiler pressure is admitted through the cock 2 and is transmitted to the diaphragm 3, and when the limit is reached it raises the weighted lever 4, at the outer end of which a small lever is attached. The other end of this lever is attached to the stationary arm 5, hence when the outer end is carried upward by the boiler pressure the valve stem 6 is raised and this admits water to the cylinder 7 from the pipe 8 through the lubricator 9 and the connecting pipe 10. As the piston in 7 is forced upward by the water pressure, which ought to be 30 lb. or more per square inch, it raises the lever 11 and this action allows the damper to close until the pressure falls about ½ lb., when the action is reversed and the damper closes.

This regulator is positive in both directions, hence if it is located so that a rigid connection can be made to the damper, weights on the damper lever are not necessary. If it is not convenient to use water at 30 lb. or more, or if it cannot be secured at this pressure from the street main, it may be taken from the boiler below the water line. In this case about 75 ft. of ¾-in. pipe ought to be used, in order to give the hot water a chance to cool before it goes into the damper cylinder, as it is designed for cold water only. When fitted in this way a man of ordinary weight, say 175 lb., can put his entire weight on the

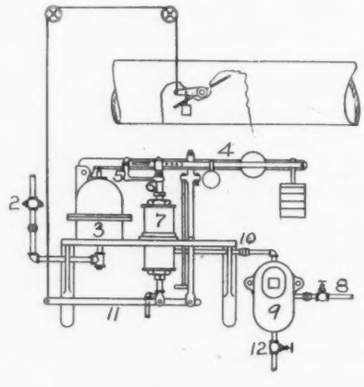


FIG. 3.—REGULATOR ATTACHED TO DAMPER.

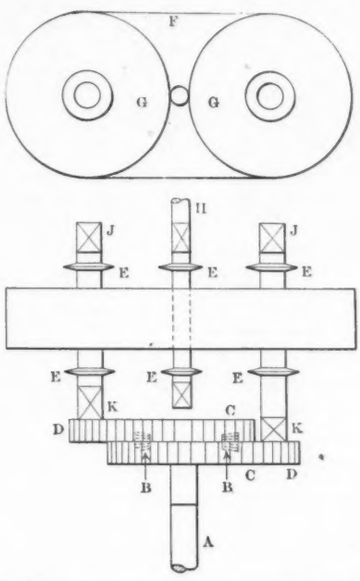
lever 11 and it will easily raise him. The lubricator is fitted with a large plug that can be taken out with a monkey wrench. The inner face of this is fitted with a receptacle for holding a piece of soap. As the water passes over this soap it is slowly dissolved and acts as a lubricant to every part with which it comes in contact. This lubricator also acts as a sediment chamber, hence it is fitted with a blow-off valve 12 at the bottom, as indicated in the engraving.

LETTERS ON PRACTICAL SUBJECTS

HIGH-SPEED, HIGH-RATIO TRANSMISSION.

The steam turbine has led to the development of a great deal of very high-speed machinery and the experimenter is often confronted with the problem of transmitting power from high speeds to low and vice versa.

The accompanying sketch shows a simple, compact and inexpensive means of doing this with moderate powers. *A* is the slow-speed shaft which drives through the differential bevel



HIGH-SPEED, HIGH-RATIO TRANSMISSION.

gears *B B*, two spur gears *C C*, which should preferably be made of fiber or rawhide. Pinions *D D*, driven by *C C*, are mounted on two parallel shafts which carry friction wheels *G G* which must be well balanced and as light as possible. Aluminum is a good material for them. They should be very slightly crowned. *F* is a belt which pulls *G* and *G* together and causes friction enough to drive the high-speed shaft *H*. The bearings *K* and *K* should have ball seats and the bearings *J J* should be mounted on slides so as to be free to move toward and away from each other; but the motion will be small. Provision should be made for adjusting the distance between *K* and *K*. *E E E*, etc., are oil slingers which keep the wheels *G G* free from oil. It will be seen that shaft *H* is driven without causing any side pressures which the high-speed bearings will not be able to take care of. Of course helical gearing will do better than this arrangement, but such gearing is very expensive and there are only one or two shops that are capable of cutting them with the extreme accuracy required. The helical gearing is also very easily damaged by lack of oil.

This apparatus is especially suitable for driving the high-frequency generator for wireless telegraphy described in the April number.

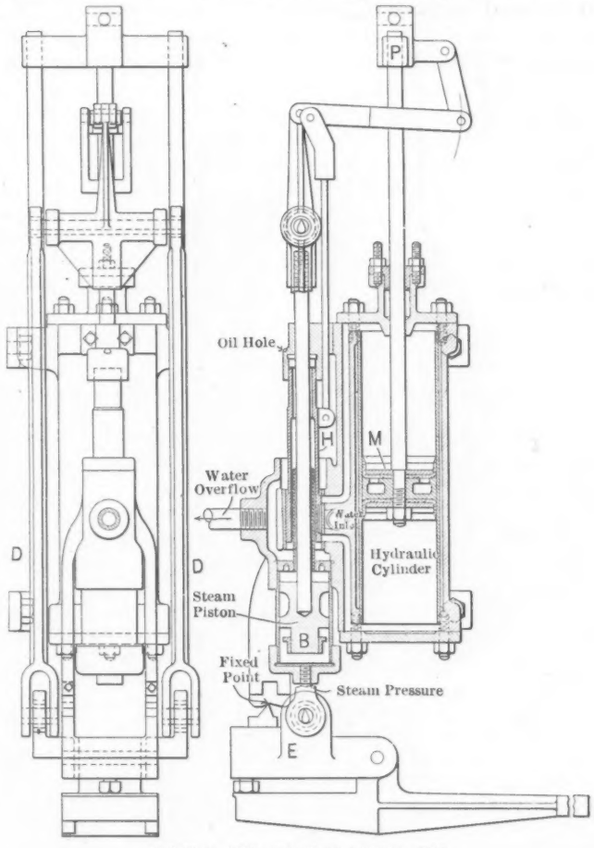
SWISSVALE, PA. A. T. KASLEY.

AUTOMATIC DRAFT REGULATION.

The May number contains an article by Mr. Wakeman on automatic damper regulators, and inasmuch as the article is confined to that class of regulators that can be called "full throw machines," it might be well to call attention to certain phases of damper regulation in connection with automatic stokers. The wide use of automatic stokers makes the subject of automatic draft regulation of increasing importance, and from a theoretical standpoint an ideal condition can be obtained if in conjunction with the automatic feed of the furnace there could be combined the automatic control of the air supply.

An automatic stoker is primarily a continuously operating device which is set to operate at a certain speed, being driven by some form of engine or motor. This condition holds until there is some change in the steam demand, when the operating fireman throttles the engine or manipulates the speed control so as to increase or diminish the fuel fed, in accordance with requirements. The fireman is advised of the increasing steam demand by the lessening boiler pressure, as shown by the gage, and he then increases the speed of the stoker. Conversely, if some unit is cut out, the steam pressure rises, and the fireman then slows down the stoker. It follows, therefore, that regulation follows the change of requirement, and the greater the volume of water contained in the boiler, or the more sudden the fluctuation, the farther behind is the adjustment. It would appear, then, that if the fireman could make the necessary adjustment the instant the steam pressure falls ¼ lb., instead of a pound or two, which is usually the minimum amount observable on the gage, that he would be just that much farther ahead, and would catch up or slack off before the steam had varied as much as under the other conditions.

Leaving this consideration for a moment, another essential governing satisfactory draft control must be considered. When the intelligent fireman notices the steam pressure falling, he knows that it is probably due to a temporary or slight increase in the load, and would not think of putting on full power, but slightly increases the speed of the stoker and opens the damper a little, just about to compensate for this slight increase. He would not think of absolutely closing the damper if the steam



STOKER AND DAMPER REGULATOR.

should rise a little, nor would he throw it wide open if the steam should drop a little. With automatic stoking this kind of extreme fluctuation is always to be avoided, and the value of steadiness of operation is well understood by stoker firemen.

One can hardly conceive of any machine anticipating the requirements of the boiler and opening the dampers or closing them before the demand for harder or easier firing occurs. Eliminating this impossibility, therefore, the ideal condition is

approached when a machine is obtained so sensitive that it will act upon a boiler pressure variation of a small fraction of a pound and, as the steam pressure varies, following it up closely by gradual changes in direct harmony and proportion with the requirements. This ideal draft regulation is always just enough to burn the coal required to generate a given pressure and is never more than this. A machine of this nature is shown herewith. A hydraulic cylinder has a leather-packed piston *M*, and crosshead *P*. A pilot valve *H* is attached to the crosshead by the system of levers shown. Lever *E* carries a weight which counterbalances the steam pressure on the under side of the steam piston *B*. The line connecting the center of gravity of the weight, and the fulcrum being at an angle to the horizontal, it follows that as this weight swings upward it also swings outward, increasing the leverage and compensating for the increase of steam pressure on the under side of the steam piston. An adjustment of this nature compensates for small increases of steam pressure, so that the machine operates upon a variation of pressure sufficient to overcome the internal friction. As this is very small, the machine practically operates with the slightest variation of the pressure. An increase of steam pressure raises the steam piston *B* and the counterweight. As the counterweight moves upward and outward, it reaches a state of equilibrium as soon as the increasing leverage equals the increase of steam pressure. This opens the ports admitting water from an independent source to one side of the hydraulic piston, and permitting the escape of the water on the other side. The movement of the piston being connected to the damper, and to the throttle valve of the engine controlling the speed of the stokers, increases or decreases the speed of fuel feed and the intensity of the draft correspondingly. A further slight increase or decrease of the steam pressure causes another slight motion of the hydraulic piston, which in this way very closely follows the variations of the steam pressure. The extreme travel of the piston is sufficient practically to close the damper, and slow the drive engine to a point where it just turns over, and the other extreme is sufficient to open the damper wide and run the drive engine at full speed. This machine, when once set to fit the conditions of coal and draft, will take care of the stokers without any adjustment whatever on the part of the operating fireman, and preserves the conditions of gradual changes without extreme fluctuations, which are so necessary to correct stoker operation.

Chicago, Ill. Joseph Harrington.

MAGNETIC VARIATIONS AND DEAD POINTS IN MOTORS.

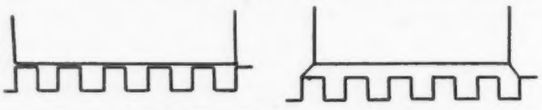
It occasionally happens in the operation of a motor that, while the machine may give satisfactory service when running, there are positions of the armature which do not give a strong starting torque and may even cause the machine to fail to start. Dead points at starting may occur with either direct or alternating-current motors and may be eliminated in both types by essentially the same method.

In the following discussion will be taken up some of the elements of design and construction which tend to cause dead points, and also the effect of these same elements on the general operation of the machine.

The general condition which may be set down as the prime cause of dead points is that of variable reluctance of the magnetic circuit with different positions of the armature. If any machine has this defect to any marked extent the armature will be held in the position of minimum reluctance by a force represented by the formula $F = \frac{(B-B')^2 A}{25.3}$, where B and B' are, respectively, the maximum and minimum values of the magnetic density, and A is the tooth area under the poles. In many cases when the unexcited armature is placed in a strongly magnetized field, the armature will resist turning by hand and when forced out of its initial position it will tend either to return to it or move to another giving the same magnetic effect.

A little consideration will make it clear that for direct-current machinery the slot-pitch and polar-arc should be so chosen that the effective arc divided by the slot-pitch will be an integer. An inspection of Fig. 1 makes evident the truth of this statement, as it shows that the number of teeth under one pole, and consequently the effective area for carrying the flux, is constant for all positions of the armature. This is on the assumption that the flux does not cover a longer arc than the pole. The condition which exists in actual practice is that the flux spreads at the pole-tips a greater or less amount, depending upon the shape of the tip, the length of the air-gap, and the slot-pitch. Under ordinary conditions the spread may be taken as about twice the air-gap, so the effective polar-arc must be considered as shown in Fig. 2. If the poles are specially shaped to give a commutating field, the maximum effective arc should be considered in determining the ratio of slot-pitch and magnetic arc.

In small motors, where the number of slots on the armature is small, the slots are sometimes cut spirally. If the pitch of the spiral is such that the slots have a lead at one end of the armature of at least one-half of the slot-pitch over the other ends, the tooth area under the effective pole will be constant whether or not the ratio of the slot-pitch to the effective polar-arc is an integer. The spiral slots may also be advantageous in making possible sparkless commutation, by providing gradual exit of the coils from the field which may not have a good commutating fringe. Shaping the pole pieces so the field gradually diminishes in intensity from the center to the edges will tend to diminish any variation in the magnetism due to changes in tooth area under the effective pole, while a design which gives a fairly uniform distribution will increase the variation.



FIGS. 1 AND 2.—RELATIONS BETWEEN POLE-PITCH AND SLOT-PITCH WITH EXTREMELY SMALL AIR-GAP AND WITH AIR-GAP OF ORDINARY PROPORTIONS.

In alternating-current motors of the induction type, the primary winding is ordinarily distributed in slots throughout the entire circumference of the core and consequently each polar-arc is broken up by the slots for coils of other phases. The polar-area is, however, the area included by one group of coils, and the polar-arc is the arc spanned by a single group of coils. In order that the magnetic reluctance shall be the same for all positions of the rotor, the effective tooth-area per pole on the stator must register with a tooth-area on the rotor, which is practically constant. One very obvious method of securing this result is to make the rotor without slots, but as this would necessitate the use of a sheet conductor and consequently an increased air-gap, it is common practice to make the number of slots on rotor prime to the number per pole or per phase on the primary. If n is the quotient obtained by dividing the primary pole-pitch by the slot-pitch and $(n+1)$ is the quotient of the primary pole-pitch and the secondary slot-pitch, the distance which the rotor will move in passing from a position of initial reluctance to another position of equal reluctance is $\left(\frac{1}{n} - \frac{1}{n+1}\right) \times \text{pole-pitch} = \frac{1}{n(n+1)} \times \text{pole-pitch}$. If the number of slots per phase per pole is the basis taken, the distance passed over is $\frac{1}{n(n+1)} \times \frac{\text{pole pitch}}{k}$, where k is the number of phases.

The frequency of the variation of the reluctance is equal to the peripheral speed of the rotor in feet per second divided by the distance passed through in one cycle, expressed in the same units, as given above. In direct-current machines, the frequency of the magnetic variation is expressed in the same way, providing the mechanical spacing of the poles is perfect. If poles are not equally spaced, the variations will take place under different poles at different instants, which will give a higher frequency.

It is interesting to note that conditions which produce minimum magnetic changes give also minimum noise. An alternator sometimes produces a hum which indicates a frequency of vibra-

tion widely different from the frequency of the current generated, which may be due in part to air currents in ventilating ducts and in part to the magnetic variations mentioned above. In turbo-alternators the magnetic variations may be responsible for a large part of the noise, because of the fact that the magnetic fluctuations may be large on account of the comparatively large slots and also because of the high peripheral speeds which would bring the vibrations well up into the range of audible sounds.

SCRANTON, PA. A. R. DENNINGTON.

THERMIT FOR EMERGENCY REPAIRS.

Among the letters on practical subjects in your issue of May, John Jackson, of Boston, makes many inquiries regarding thermit, its practicability for small repairs on pipes, etc., its composition, reaction and finally why the electric worker is not equipped with thermit as part of his regular outfit. Perhaps I can answer many of the questions to his satisfaction, as some working experiences with thermit have posted me somewhat.

Thermit is a mixture of finely divided aluminum and iron oxide which creates a heat of 5400 deg. Fahr. in 15 seconds after being ignited, this immense heat fusing any fractured or broken parts with the added metal required and carefully prepared for welding. It requires some practice and knowledge in handling and I suspect that the cost of the prepared thermit and the special tools required for even small repairs, make against its very general use along the lines Mr. Jackson mentions.

Repairs made with thermit are possible in all the ways he mentions, but once made are certainly permanent. This would not prevent thermit being considered in repairs of pipe fittings, heaters, pumps, boilers, wheel shafts, for they can be welded without removal and are then generally stronger than before the break.

The engineer, marine, locomotive or stationary, can fully attest its value, for it has been proved in the field of each. The process in outline is briefly to file and brighten ends in butt-weld and to clean out broken and jagged surfaces by drilling and boring in repairing a break or crack. A mold is then clamped about the place to be welded, allowing room for the addition of sufficient thermit to make a button or ribbon of the mixture overlapping the weld. The part to be welded is first heated with a gasoline blow-pipe to allow for the proper fusion of the original metal to the new, the temperature of the reaction being twice that required to melt steel itself. The thermit is heated in a crucible for ordinary repairs held in tons, or for larger repairs upon a special stand, and when ignited by a charge of special ignition powder the reaction takes place almost instantly with intense heat (confined in the mold) and a blinding light. The worker and his helper should both wear blue glasses to see better and to protect the eyes.

The special outfit prepared by the manufacturers of thermit

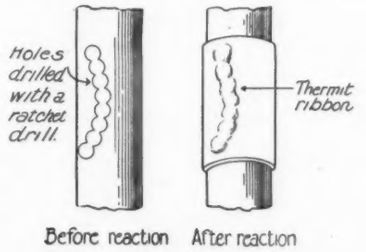


FIG. 1.—REPAIRED PIPE.

can only be purchased of them, and while the cost is not excessive for large work, it is certainly a considerable item for every-day work, and the skill and practice required, as well as the danger from neglect of precautions, will keep it out of the ordinary shop.

I have assisted in small repairs, pipe elbows, split joints and cracked rings where the work was to be done without displacing the broken parts in the following simple manner: The ordinary plumber's crucible and tongs were used after the former was fired out clean, to remove slag, etc. The split pipe to be repaired was drilled the entire length of the crack and then a mold made by taking old flanged pipe of larger diameter, slitting a groove around inside two halves and clamping them over the part to be repaired with long iron rods to hold them in place. This mold was set in a box of fine sand about 20 in. square, which was shoved under the mold each time a weld was to be made and drawn out after the metal cooled. A hole was drilled funnel-shape in the top of the old flanged pipe mold sufficiently large to allow of the right quantity of thermit,

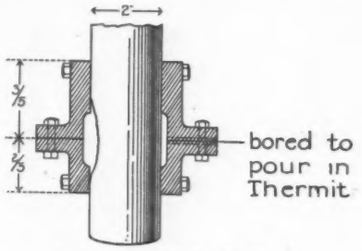


FIG. 2.—SECTION OF MOLD.

this being sold in measured portions according to pipe diameter, in this case 2 in. extra heavy. The clamps holding the mold to pipe are tightened as the ignition powder is added, setting off the reaction, which successfully fuses the new metal with the old into a homogeneous mass which sticks out from the pipe as a burr or ribbon and can be filed down or otherwise removed if desired. The repair is permanent to that part.

The cost of the operation is what makes it out of general reach. As figured by the thermit people, using their complete outfit as they recommend would have made our repair cost

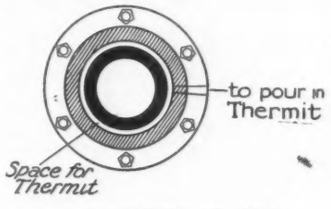


FIG. 3.—SECTION OF MOLD.

$1.56 per weld. By using our own tongs and crucible and making a pipe mold, we brought it down to about 90 cents. Even this is costly, but its use lies in larger fields and is correspondingly more costly. For all repairs over 4 in. in diameter fire clay molds must be used and the reactions double in cost and in quantities of material used. Nevertheless it is new, and as its use becomes more general and engineers recognize its undoubted utility, Mr. Jackson's engineer may then include a thermit outfit along with his indicator, his lubricator and his license.

NEW YORK. F. W. MOORE.

STEAM-PIPE HANGERS.

The writer was recently called in to ascertain the reason for a certain engine's frequency in breaking out the cylinder head. Four times, within six months, was the unenviable record of the engine, which had never given trouble before the date alluded to. Upon looking the engine over, it was found to be arranged with a very small home-made separator in the steam pipe, close to the throttle of the engine. The steam pipe was a long one, over 150 ft., but it was well insulated with magnesia pipe covering besides being enclosed in a box where it went out of doors from one building to another.

The engine was used for driving an electric generator in a manufacturing establishment and the breaks had occurred in two periods; two of the breaks coming within three weeks of each other in the late autumn, the other two breaks occurring this spring within a week of each other, the last break not yet having been repaired. The first apparatus examined, after looking over the engine, was the boiler, which was a fine high-

pressure tubular concern, with dry pipe but no dome. Nothing wrong could be found at the boiler, or at the engine, to cause trouble, and nothing remained to be examined except the steam connection, which was 6-in., screwed-joints, black pipe, evidently of standard make. The pipe extends through two warehouses and was suspended from overhead by means of home-made hangers similar to that shown by Fig. 1, evidently forged from ½-in. iron rod by the engineer, when the plant was set up. The hangers were strong enough and there were plenty

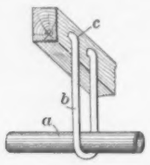


FIG. 1.—ORDINARY PIPE HANGER.

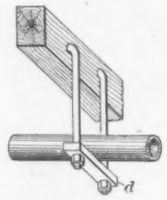


FIG. 3.—ORDINARY HANGER WITH YOKE.

of them, the timbering of the buildings evidently causing hangers to be located at quite short intervals, say 6 ft. to 8 ft., in order to prevent unsupported pipe lengths of 14 ft. to 16 ft.

Nearly all the space through which the pipe extended was dark, and the examination had to be by lantern-light. By chance, while wandering through the factory on the floor above the steam pipe, something led the writer to note that the floor was exceedingly uneven, in some places appearing several inches higher than other places only a few feet distant. A closer examination led to the discovery that some portions of the floor were heavily loaded with stock to be manufactured, and the floor had settled badly where the stock was piled the heaviest.

A question or two brought out that the stock had been in the mill only a little more than two weeks, and was put in about the time the engine broke down

The cause for the breaking of four cylinder heads by water in the cylinder was thus evident. The steam pipe had been forced down by loads of stock piled on the floor which supported the pipe. Pockets were thus formed in the steam pipe which partially filled with water when the engine was running. When an extra and sudden call for steam came on, about an hour before sundown, each time the head blew out, the increased flow of steam evidently caught up some of the water in one of the pockets near the boiler and carried that portion of water along with the steam.

Several more pockets well filled with water were in the path of the steam, and the result was that all the pockets were emptied by the rush of steam, and by the time it approached the engine, the steam pipe was almost full of water of condensation, which simply drowned out the little separator and swept down

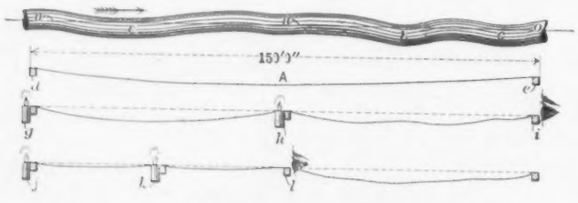


FIG. 2.—LINING A STEAM PIPE IN THE DARK.

into the engine and put that machine out of business too. The trouble was all in the steam pipe, so a line was run through the dark store rooms, alongside the pipe, as shown by Fig. 2. The line was first stretched "neck and heels" from each end, then the line was straightened. The pipe is shown in its sinuous course from boiler to engine with the line *m*, *n*, *o*, stretched tight along its 150 ft. of length. The pockets at *a*, *b* and *c* will be noted. The arrow denotes the direction of flow through the pipe and the water originally picked up in pocket *a*, reinforced by the water from pockets *b* and *c*, was sufficient to flood the little separator and push out the cylinder head of the engine.

No light was obtainable in the mill, except from petticoat lamps, lanterns and candles. Some of the latter were procured, the line stretched "neck and heels" at *f*, between targets *d* and *e*, then target *h* was put into position as shown. The candles *g* and *h* were fastened to the back of each target by three wire nails driven on an angle and the candles slipped between them. Then with the eye at *i*, target *h* was moved exactly in line with *g* and *i*, as determined partly by sighting the candles *h* and *g*, and later by sighting more closely to the illuminated edges of the targets at those lights.

After target *h* was in position and fastened, the eye was transferred to that target as shown at *l*, the candle put alongside another target at *k*, and the three points, *j*, *k* and *l* brought into line as before. It was found that the pipe originally had a pitch toward the boiler. This was changed by adding a short nipple above the boiler, giving the pipe an inclination of 4½ in. toward the engine. The writer prefers this arrangement, as then there is always a steady flow of entrained water in the direction of the steam, whereas, with the drainage toward the boiler, the flow of steam sometimes holds up the water until an extra rush of steam takes place, whereupon the water is brought over into the engine by the rush of steam. After the line had been supported and all the sag taken out of it, as shown at *n*, *m*, *o*, the condition of the pipe alignment was plainly discernible and steps were immediately taken to cure the trouble. It was not thought advisable to try to level the floor so as to bring the pipe straight. What was done con-

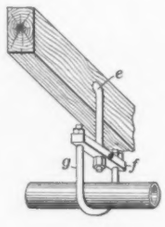


FIG. 4.—SINGLE HOOK AND YOKE HANGER.

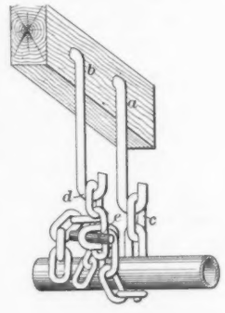


FIG. 5.—CHAIN AND HOOK PIPE HANGER.

sisted of placing enough posts along the line of pipe to prevent the floor from going down when loaded. Then means were taken to bring the pipe to the line and keep it there.

Pieces of 2-in. by 4-in. scantling were placed underneath the pipe, one at each pipe-hanger, then wedges were driven under the scantlings until the pipe was in place. There was no means of adjusting the old pipe hangers, except by pulling them out and driving them in again at the required height. This did not work at all well. In fact, it is a mighty good job to hang pipe upon the hangers shown by Fig. 1, and to have the pipe straight when the job is done.

The hangers were so firmly driven into the timbers that they could not be removed without breaking half of the hooks and without badly distorting most of the rods in the attempt to pull the hooks out of the timbers, that it was decided to let them remain and block up between the hangers and the pipe, until the latter was brought into alignment. All sorts of schemes were proposed by the management for shortening some of the hangers so that adjustment could be made, one member proposing that the hanger be cut off below the pipe and threaded as shown by Fig. 3, a yoke applied and the hanger-rods threaded below the yoke *d*, the adjustment being made by screwing the nuts up or down. Another member of the company wanted to cut the hanger above the pipe, remove one leg and let all the weight of the pipe come upon rod *e*, which was to be connected with the pipe by means of the yoke *f* and the U-rod *g*, which was to be made from the remainder of the original hanger and

threaded as shown by the engraving, Fig. 4. Still another wanted to apply an arrangement somewhat as represented by Fig. 5, in which the old hanger was cut off and the lower ends of the rods turned up as hooks, as shown at *a* and *b*. Chains were to be hung to each of the hooks, at *c* and *d*, and the ends of the chain brought around under the pipe and fastened by the old device known as the "toggle and fid." The pin doing duty as the "fid" is shown at *e*.

To secure adjustment to any height within reasonable limits it was suggested to use chains with links of different lengths, as represented by Fig. 6, at *a* and *b*, thus adjusting the height of the pipe in steps. The chain *a* has two links to 6 in., as shown, while chain *b* has a pair of links to each 6¼ in., making the links respectively 3 in. and 3⅛ in. long. Changing the length of both sides of the hanger ⅛ in. would therefore give a vertical adjustment of 1/16 in. in the height of the pipe. The writer suggested that the cost of thus changing the pipe hangers would cost much more than it would to put in entirely new hangers of an approved adjustable type similar to those shown by Figs. 7 and 8. The former shows two forms of hanger, style A being adapted to light pipes under 4 in. in diameter, while style B is fitted for heavy pipes of larger diameter.

Style *A*, Fig. 7, is made of malleable iron, the point *c* being

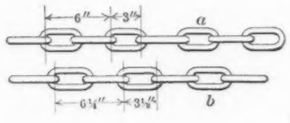


FIG. 6.—DIFFERENTIAL CHAIN ARRANGEMENT.

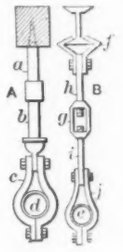


FIG. 7.—ADJUSTABLE PIPE HANGER.

threaded similar to a lag screw and screwing into the timber to which the pipe is to be attached; a length of small steam pipes, *b*, is cut and threaded to fit the drop of the hanger as found necessary. The screw point *a* has its lower end pipe-threaded to fit the coupling which connects the point *a* with pipe *b*. The clips *c* which encircle the pipe are usually made of malleable iron in two pieces, and they are bolted together and to the fitting into which pipe *b* is screwed. The hanger shown at *B*, Fig. 7, may be fitted either with the beam-clips *f* or the screw point *a*, as required. The vertical adjustment at *A* is made by varying the length of pipe *b* and by screwing point *a* farther into the timber. Besides the fixed adjustment in hanger *b*, by changing the lengths of rods *h* and *i* there is a turnbuckle *g* which permits the fine adjustment to be made with great

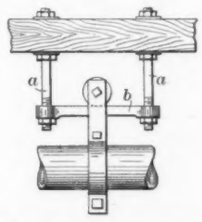


FIG. 8.—ADJUSTABLE EXPANSION HANGER.

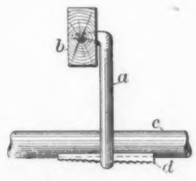


FIG. 9.—ROD AND RATCHET WEDGE HANGER.

exactness. The clamp clips *j* are similar to those shown at *c*, and they are attached to pipe *e* in the same manner as to pipe *d*.

A still better form of pipe hanger is shown by Fig. 8. This hanger is adjustable to any height or drop, by varying the length of bolts or rods *a*, *a*, which may be cut to any length and are adjustable at any time by means of the nuts supporting yoke *b*. The travel of the pipe, caused by the linear expansion, is taken care of by the little trolley wheel which runs upon yoke *b* and permits the pipe clamp to travel with the pipe instead of swinging as is necessary in all the other hangers described above, and thereby raising the pipe vertically more or less as the hangers move pendulumwise with the expansion and contraction of the steam pipe.

Thus far the owners had not succeeded in solving the problem of readjusting the old hangers to the pipe in its new position. The engineer then came forward with a sketch of a little casting, as shown at *d*, Fig. 9. This casting was made with a taper-curved cross section to fit both pipe and hanger. The

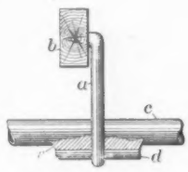


FIG. 10.—ROD AND SHOE HANGER; CEMENT ADJUSTED.

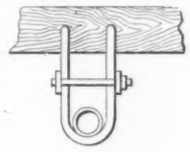


FIG. 11.—RAISING A PIPE BY CLAMPING THE HANGER.

little notches served to hold the ratchet wedge from moving endwise as the pipe expanded or contracted, yet it was possible to move the wedge endwise (by raising the pipe a trifle), thus securing the necessary vertical adjustment to pipe *c*, the old hanger *a* remaining unchanged as driven into beam *b*.

The above noted arrangement was the most sensible one proposed, but there was just one thing in the way of adopting it, and that was: It would require considerable time to make the pattern and obtain the necessary castings, one for each of the hangers. Again, as some of them would have to be blocked up 4 in., there would be quite a bill for iron by the time the job was done. The work was finally done by wedging the pipe up as noted, and temporarily blocking it. When there was over 1 in. between the hanger and the pipe, a piece of sheet iron, ⅛ in. thick and 12 in. long, was bent in a semi-circle to fit the hanger, as at *d*, Fig. 10, and placed in position as shown. The pipe was blocked on the thick sheet-iron by means of a brick or two, or an old bolt nut or a piece of scrap iron as happened

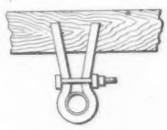


FIG. 12.—CLAMPING A PIPE HANGER.

FIG. 13.—PIPE HANGER SECURED BY CLAMP-DOG.

to fit the space. Then the space between the shoe and the pipe was filled with cement mortar, which was well pointed in, and left to set.

Where there was less than 1 in. adjustment—and the pipe was so located that none of the hangers had to be lowered—a bolt and yoke clamp was put across the hanger rods above the pipe as shown by Fig. 11, and screwed up until the pipe had been raised the required distance, as shown by Fig. 12, where the rods had been pulled almost together before the pipe had been raised the necessary amount. Having raised the pipe to the desired point, measure the distance between the clamp pieces, then have a double ended hook made with just the same distance between the hooks. Screw up the clamp bolts until the double hook can be slipped over both hanger rods, then remove the bolt and yoke-clamp and drive the double hook into position as shown by Fig. 13, and the necessary adjustment is complete.

The pipe was very quickly hung up in this manner, and the cost was very slight. It is safe to say that the owners will never have another cylinder head blow out by water being stored in the steam pipe while the engine is running.

WILLOUGHBY, OHIO. JAMES F. HOPART.

QUESTIONS AND ANSWERS

Why is it that transmission lines carrying high-tension currents are almost invariably of bare wire? D. S. S.

Because ordinarily insulation not only increases the size and weight of the wire and thus offers a greater surface for sleet, snow and wind, but the insulation is of no worth.

Is it advisable to place fairly large transformers on a pole for stepping down the potential for a commercial circuit of 200 kw? S. B.

Three single-phase transformers aggregating 200 kw can be safely erected on poles by setting two poles closely together and constructing a platform between them for holding the transformers. The platform should be placed quite low, say about 20 ft. from the ground.

How can the direction of rotation of a three-phase motor be reversed? We have tried various combinations in an effort to get the motor to operate in a reverse direction, but without success, and now the motor only runs at about one quarter of its former speed. P. S.

The direction of rotation of a three-phase induction motor may be reversed by interchanging the connections of any two of the three wires leading to the stator winding. The fact that your motor runs at a considerably reduced speed would indicate that one phase-winding is reversed. This would also result in overheating and a pronounced hum would be evident at starting.

What causes one wattmeter to run backward where two meters are used on one circuit? R. S. B.

We suppose that you refer to watt-hour meters of the motor type, used on a three-phase circuit. Either a wattmeter or a watt-hour meter will indicate a negative reading when the current in the series coil is out of time phase with the electromotive force across the shunt coil by an angle greater than 90 deg. This condition exists in a three-phase circuit when the angle of lag is greater than 60 deg., because there is an initial time-phase displacement of 30 deg. These facts were discussed fully in the September, 1907, number.

I have a four-valve engine running at 122 r.p.m. belted to a dynamo and desire to operate the set in multiple with another on an alternating-current circuit. The engine has a large flywheel and I desire to know whether there is any likelihood of trouble due to pulsations in speed from such an engine. W. J. L.

A four-valve automatic belted engine running at 122 r.p.m. should be able to drive an alternating-current generator operating in parallel with a similar generator driven by a similar engine. However, the successful operation depends as much on the characteristics of the generators as it does upon the design of the engines. The only method of determining with satisfaction just what results may be expected from the parallel operation of alternating-current generators is to submit the problem to the builder of the generator.

I would greatly appreciate your kindness if you would explain the meaning of the equation

$$\mu = 2800 - 3.2\,\frac{(7500 - B_m)^2}{10^5}$$

J. C.

It is impossible to derive any equation which will accurately determine the permeability of magnetic material under all conditions, because the permeability varies both with the mechanical composition of the material and with the mechanical treatment to which it has been subjected. The permeabilities of samples which one would expect to find absolutely identical, vary as much as 25 or 30 per cent. For most practical purposes, even an approximate estimate of the permeability is sufficient. The equation mentioned is one which fairly well represents the mean permeability of quite a large number of samples, although it is not accurate for any one single sample. The equation has no physical significance; it merely represents results as they are found to exist in nature.

To what extent should a central station company insist on the proper distribution of a customer's load across the three-wire system? E. C. S.

Obviously some attempt should be made to keep the three-wire system balanced. In New York City the requirements are quite rigid. All lighting circuits requiring over 5 amp must be equally divided and all motors having a rating over 5 hp must be connected across the outer wires, the potential between which is 240 volts. In another large city in New York State no attempt is made to balance the three-wire system, and yet it has been found that the circuits are rarely out of balance in the city referred to. Curiously enough the three-wire network which is tied together seems to have a tendency to balance itself without extra precautions being taken; an overload on one side being usually counterbalanced by an overload on the other side of the system. We know of no other city where the requirements as to balancing are as rigid as in New York.

What is the phantom circuit in telephony, and what is the function of the repeating coil used in connection with it? J. V. Q.

It is customary between telephone exchanges having considerable toll business to have order wires for the switching operations. When the distance is great, a special circuit called the phantom is sometimes used. This circuit is placed on the best lines, as the least difference in balance will cause the phantom to become noisy. Repeating coils are placed in the trunks and taps are taken out of the middle of the line side of each. These taps are connected to one-half of the secondary of a double-wound induction coil and compound receiver. A double-wound head telephone is connected so that one winding is in the phantom circuit at all times. By pressing a button at the distant station the transmitter, which is normally connected to the regular primary winding, is connected on the primary winding of the special circuit and the operator can converse over the phantom.

What part do the series resistance and reactive coil play in lightning-arrester equipments for central stations? P. L. O.

The purpose of the series resistance is to make the discharge non-oscillatory. If no series resistance or other oscillation-preventing device were incorporated in the circuit, a discharge from line to ground or vice versa will be oscillatory and may cause a low-frequency surge in the system which may be more destructive than the lightning itself. The greater the series resistance interposed, the less is the discharge ability of the arrester. The reactive coil protects the station against a high-frequency oscillation, but offers no protection against static charges of low-frequency surges, because the amount of reactance which can be introduced is limited. The reactance employed must be less than would be appreciable at the normal frequency of the system, and therefore less than would exert an appreciable effect on low-frequency surges. Its purpose is to obstruct a high-frequency oscillation, and it is not a general protective device any more than the series resistance.

In a medium size steam-driven station having a storage battery, what provision should be made for reserve equipment? F. M. C.

There is no definite rule which may be followed regarding the proper amount of reserve equipment to install. It is becoming quite common now to operate reciprocating engines and generators at slightly less than normal load and to depend upon their overload capacity in case one is instantly disconnected from service. During peak load all units carry approximately full load, and if one is disabled the overload capacity of the others and the battery are depended on to tide over the crisis. In case of sudden mishap the battery supplies the necessary energy until another unit can be started. Duplication in the boiler plant is avoided by arranging the steam piping so that all boilers and engines are connected to a ring main suitably divided by valves, so that any group of boilers can be used with any combination of engines. The feed-water lines are similarly arranged. In some large stations the plan followed is to make each unit virtually a separate power station in itself, means being provided for shifting the load from one set to another, and from one battery of boilers to another, so that a very flexible arrangement results. In well-managed stations the actual number of times service is interrupted, due to power house failures, is very small indeed. The majority of interruptions to the service are due to causes outside of the generating station.

Motor-Driven Refrigerating Machinery

By R. N. DICKINSON.

To the wide-awake central-station manager there is a comparatively new power market opening up, that of the motor-driven refrigerating outfit. The size of this market may be imagined when one stops to consider the number of commercial enterprises using ice; for in nearly every case the ice may be displaced by the more convenient and less bulky artificial refrigeration. Markets, hotels, restaurants, dairies, chocolate factories, fish dealers and packing houses all need cooling facilities of some kind. The majority of them use from one to six tons of ice per day.

If this business can be obtained for the electrically-operated refrigerating machine, a motor of from 3 to 15 hp may be in-

Name_____ Address_____

	Dimensions of Room			Used for	Lbs. Cooled Daily	From of	Outside Temp.	Desired Temp.	Thickness Wall	Wall Construction	In Door often open?
	Length	Hight	Width								
Room I											
Room II											
Room III											
Room IV											
Room V											

Voltage_____
A.C. D.C._____
Water Supply_____
Temp. " _____
Max. Amt. Ice Now_____

FIG. 1.—CARD FOR FILING INFORMATION.

stalled, according to the amount of cooling needed. The table herewith shows the average power required by the different sizes of refrigerating machines.

This load will be of great assistance in straightening out the station load curve, as it will be at a maximum in the hottest weather and in the warmest part of the day, when the lighting load is off and the power load is apt to be below normal.

Tons per 24 hours.....	0.45	0.9	1.3	2.5	4	5	8
Horse-power required.....	1	2	3	5	7½	10	15

For the average requirements it will be unnecessary to operate the machine all the time, and as the minimum capacity will be required at night and in cool weather, it may be kept off the peak entirely, if desired. These conditions are favorable to a low price per kw-hour. At the present time a rate of 3 cents makes it possible for the outfit to compete very successfully with ice.

The refrigerating manufacturers are of course pushing the sale of their systems, but they do not cover the field closely enough. Each central-station man ought to get out and canvass his own town and get every possible customer connected. The central-station company doesn't care about the refrigeration end, but it most assuredly ought to be concerned about the motor load.

Before beginning the actual campaign, the various machines on the market should be examined, and one or two reliable ones determined upon to be recommended and sold to the customer. In general, these outfits are made up of a compressor, condenser, liquid receiver, oil trap, expansion valve and the cooling coils. Fig. 2 is a sketch showing the relative connections of the apparatus. *A* is the compressor, driven by the motor, usually with a belt-tightener head or silent chain. (Most compressors are of the slow-speed type, running at from 100 to 200 r.p.m., according to size and make.) From the compressor the hot anhydrous ammonia gas, under pressure, passes to the condenser *C*. This condenser is built up of lengths of 1¼-in. water pipe inside 2-in. ammonia pipe, so arranged that water and gas flow in opposite directions. Here the gas is liquefied by the pressure and cooling, and drops into the liquid receiver *R*, which is simply a strong iron tank. The liquid ammonia is then forced by the pressure to the expansion valve *V*, which allows it to expand into the cooling coils *E* or the expansion coils as they are usually called. These coils are placed in the box which is to be cooled, and in them the ammonia is vaporized by the heat in the box, thus absorbing the former. As many boxes and coils may be put in series as may be desired. After being vaporized the gas is pumped through the compressor again. There are two or three completely automatic systems on the market which claim even less attention than the ordinary systems, and a somewhat better economy. However, their first cost is quite high.

As to the actual methods of getting business, the manufacturers will be found more than willing to supply literature and suggestions, and to even loan a salesman for a time. Some central stations act as regular agents, but this plan is not so good as for the company to act more in a consulting capacity, and to encourage competition between a few of the companies building the best outfit.

One of the station's regular solicitors may be used on the work after getting some pointers from the refrigerating man. But a better plan is to employ a technical graduate who has had a couple of years in a refrigerating manufacturer's shop. Several of the latter are training electrical men for this very purpose, as they can handle station business and be ready for any missionary work in the refrigerating line also.

After some judicious advertising, the manager should get a list of all the ice users in town, and find out the size of coolers, temperatures desired, amount of product cooled, etc. This information may be filed on a card, something as suggested by Fig. 1. Then the size of outfit needed can be figured and the proposition made.

Right here it might be well to say a word about figuring on the outfit needed. The expression, "pounds duty per 24 hours," means the same amount of cooling as would be given up by the same number of pounds of ice per 24 hours. There is a leakage of heat through the walls of any refrigerator. The amount of this, per 24 hours, expressed in B.t.u.'s per square foot of surface is $= (t - t)$, K, where t is the outside temperature. t the inside temperature, and K a constant depending upon the insulation of the walls. For ordinary, well-built butchers' boxes, K is about 4 to 6. So, to figure the duty of any given box, find its surface in square feet, multiply this by the difference between the inside and outside temperatures and multiply this product by K. This will give the number of B.t.u.'s leaking into the box per 24 hours. If any product (meats, etc.), are to be cooled find the product of pounds times specific heat time $(t - t)$ and add it to the duty of box. Divide the total number of B.t.u.'s by 144 and the result will be the duty in

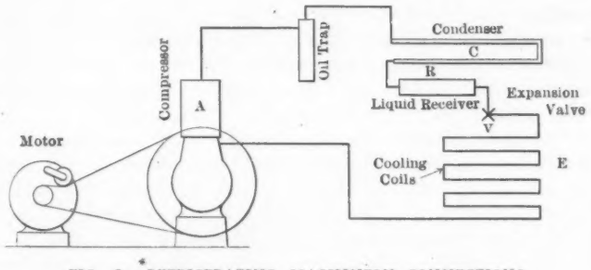


FIG. 2.—REFRIGERATING MACHINERY CONNECTIONS.

pounds per 24 hours (144 is the number of B.t.u.'s equivalent to the melting of one pound of ice).

Systems are usually rated in tons duty per 24 hours. For making ice the capacity of any given outfit is one-half its capacity for refrigeration.

After calculating the duty and the contract price, which will be supplied by the manufacturer, the manager should get after the prospective customer, using the manufacturer's stock arguments—economy, saving of all the old ice bunker space, clean, dry cold, no slop or drip, no ice handling, even temperatures, very low temperatures if desired, etc.

Whether a town be large or small, some attempt should be made to introduce motor-driven refrigerating machinery, and if results are not obtained it will be the fault of the solicitor rather than of the apparatus.

Electric Drive for Machine Shops, Railroad Shops and Manufacturing Plants Using Machine Tools and Woodworking Machinery.

By Norman G. Meade.

THE commercial side of motor drive has been considered quite fully in previous articles by the writer, but the engineering features are fully as important to a new-business department and should receive proper attention. The selection of equipment for various industries requires some knowledge of the operating characteristics of each class and an intelligent comprehension of the requirements to be met by electric motors. Not alone should the motor receive attention, but the auxiliaries, including starting and controlling apparatus, panel and switchboard, wiring, etc., must be given due consideration.

It is important that every part of an electrical installation be of the highest grade, both in construction and material. The best quality of motors poorly installed may give much trouble or a poor motor used in connection with the best wiring and auxiliaries give equally poor satisfaction.

Again, if the installation is of the highest character and motors with unsuitable characteristics for the particular work they are to perform are installed, the operation of the installation will not be good. It will be seen from the foregoing remarks that the success of any plant depends upon the proper selection of motors for each specific service, therefore particular care must be exercised to analyze thoroughly the character of the machine to be operated before deciding upon the type of motor to be used.

In general, for cranes, hoists and similar applications, series-wound direct-current motors with regulating and reversing controllers should be used, although the variable-speed type of induction motor gives good satisfaction for hoist work and may be adopted if direct current is not available.

That class of machinery having a reciprocating motion and requiring excessive power at reversals should be operated with direct-current compound-wound motors. For machines that operate at various speeds a direct-current, adjustable-speed (by field weakening) motor is recommended. With adjustable-speed motors a controller should be used, as it is important that the starting and regulating resistance should be controlled by the same handle. For group drive and machines operating at constant speed, either a direct-current, shunt-wound motor or an induction motor may be used. The inherent operating characteristics of both types are similar, but the simplicity of the induction motor commends it for use where alternating current is available.

The conditions under which machine tools operate are so varied that it is impossible to make any general statement of all the possible operating conditions. The governing factors are always important, as, for instance, the character of the work machined, the kind of material cut, the speed of the cutting tool, the quality of the tool steel, the method of treating the tool steel, the stiffness of the machine tool proper, the strength of the gears, etc. All should be taken into consideration in fitting a motor to any particular machine tool.

Broadly speaking, machine tools may be divided into two classes: those with a direct rotary motion, either of work or cutter, and those with a reciprocating motion, either of work or cutter. Under the first classification come lathes, boring mills, milling machines, drill presses, etc.; the second class includes planers, shapers, slotters and machines of similar character.

In wood-working shops electric motors are particularly applicable to the operation of the machinery because of the intermittent character of the work and the high power required. A great saving is made possible by the ability to shut down any machine not in service and to operate a single machine without driving a large amount of shafting and a number of machines which are doing no work. The power required by a wood-working machine is much greater than that needed by a metal-working machine of corresponding size. The energy to be transmitted by the distribution system is, therefore, much greater and, consequently, the transmission losses are of more importance. For this reason, the saving made possible by electric transmission will be proportionately greater. Again, wood-working machines can often be more conveniently placed with regard to the work to be done if they are electrically-driven and do not need to be located with special reference to a driving line shaft.

The power required to drive wood-working machinery varies greatly according to the quality and condition of the lumber used, the speed of the feed, the depth of the cut, and more particularly the condition of their knives and cutting edges. One of the great incidental advantages of the electric driving of wood-working machinery arises from the fact that a meter may be inserted in the supply circuit of any machine, indicating the energy required by the motor. A comparison of its readings will show quite closely whether the working parts of the tool are in good order, the feed and cut of the right amount, and the cutting edges sharp. All these points will be apparent when the meter points out that the energy required for a given work on either green or dry lumber may be easily increased 300 per cent if the knives are dull, over that demanded when the knives are sharp.

As already stated, the operation of machinery by electric motors has an exceedingly wide field, but no class of establishments exemplifies the adaptability of electric drive more than wood-working shops, machine shops, railroad shops and general manufacturing plants. In machine and railroad shops the large work handled necessitates extensive buildings and the use of great lengths of line-shafting and belting, if power is transmitted from a central source. Rush repair jobs are frequent and require a great deal of overtime and Sunday work, when power requirements are small, as but sufficient machinery is operative to complete the particular work in hand. Mechanical transmission of energy under such conditions is wasteful in the extreme, owing to the surplus energy required to overcome the friction of shafting and belting throughout the shops.

There are many other considerations in connection with energy transmission, one of the most prominent being the layout of the plant, which is especially important in railroad shops, as they are generally made up of a number of separate buildings aside from the main machine and erecting shop, such as boiler shop, carpenter shop, tank shop, pipe shop, etc., which are generally scattered, widely distributing the energy requirements and necessitating the use of a number of prime movers. Where engines are used, steam is either supplied from a central source or by individual boilers forming a combination unit with the engine. The former arrangement is exceedingly poor from an economical standpoint, owing to the low efficiency resulting from the usual excessive condensation which takes place in long lengths of steam pipe. Either method involves the expense of skilled attendants, which amounts to a considerable sum annually. These conditions are, however, rapidly changing, electric motors are superseding steam equipments and have many times proved that they fulfil all requirements—reducing operating expenses, requiring a very small amount of attention, providing a power that is perfectly reliable, and reducing the time consumed by starting, stopping and changing speed to a minimum.

The increased use of electric power is directly traceable to certain decreases in the cost of production incident to its use. While some of the economies are obvious, others are more or less indirect. Increase in operating efficiency—i. e., increased production per unit of power in cases where variable-speed motors are used for driving machine tools—is an obvious reason for adopting the electric motor. While an increase in production and a decrease in operating expenses in proportion to the output are extremely desirable, it is probable that the factor which has made the electric motor a universal necessity has been the reliability and convenience of the drive obtained by

its use. The word "efficiency" in connection with the operation of industrial plants must be used in its broadest sense and include not only economy in the consumption of energy, but must also recognize decreased unit cost of output, although this cost per unit usually involves increased wages to individual operatives where a personal-effort system is in vogue.

Having passed over the general advantages of electric drive, the electrical equipment next demands attention. For large shops covering considerable area and operating a good many machines that operate at constant-speed, a combination of direct- and alternating-current systems is advisable. In such cases a motor-generator set is used to obtain either direct or alternating current, depending on the central station's system. As alternating-current transmission is generally used, the suggestions for the equipment will be treated from that standpoint.

Many engineers differ as to the advisability of using both direct- and alternating-current motors, but the extreme simplicity of the induction motor and the minimum amount of attention required, unquestionably commends it for constant-speed service and, further, the standard maximum voltage for adjustable-speed type is about 220 volts, which confines the distribution system to rather narrow limits if economical distribution is taken into consideration. Another feature to be thought of is that there are generally outlying buildings located at some distance from the center of distribution where power is required for operating various classes of machinery. A familiar application in connection with railroad shops is the coal and ash conveyor at the coaling station. To reach outlying applications alternating current has an advantage over direct current, as high voltage motors may be used.

An important factor in estimating the energy required is the load factor of the plant. From tests made in machine shops the load factor has been found to vary from 25 per cent to 40 per cent, depending on the equipment. For a modern electrically-driven shop using a combination of group and individual drive a conservative load factor would be about 35 per cent. To illustrate, assume that there is a total rated motor horse-power of 100, then the required power would average 35 hp. For wood-working shops the load factor, determined by tests, varies from 30 per cent to 40 per cent, depending upon the equipment. For electric traveling cranes the power required will be approximately as follows:

When only a few cranes are used the distribution system should provide for power equal to the summation of the motor horse-power; when 10 or more cranes are used, the power will approximate 80 per cent of the above; when 20 cranes are used, the power will approximate 70 per cent of the above, and where over 30 cranes are used, 60 per cent of the total motor horse-power is a safe estimate.

From the foregoing data the power capacity required may be fairly accurately computed. It is always advisable to allow a margin for future extensions and possible overloads, so that a distribution system of somewhat larger capacity than actually needed should be installed.

For manufacturing plants or shops of considerable size, it is advisable to provide a small separate building for the transformers, motor-generator set and switchboard. The building should be located as near the center of distribution as possible.

The wiring of the plant is an important factor, as the efficiency of the entire installation may be greatly reduced by improper distribution. It is always desirable to divide it into several main circuits extending from the center of distribution so that an accident occurring to one feeder will affect the machines connected to it only. Open wiring, well supported upon approved porcelain insulators, is serviceable for overhead work.

A good plan to follow is to wire the ceiling below for the motors located on the floor above, as by this means the necessity of running wires down the side wall or posts is eliminated. For the ground floor the wiring should be placed in conduits beneath it. Motors suspended from the ceiling or suspended from the side walls may be connected to the ceiling wiring on the same floor. Good mechanical construction and the best material and workmanship should be employed.

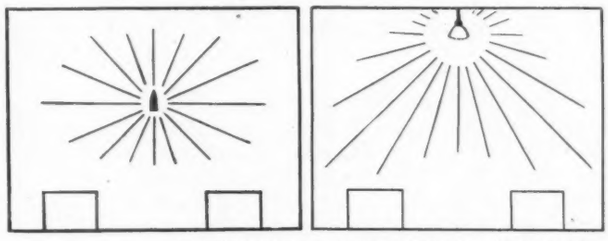
Meeting Gas and Gasoline Competition in Small Stores.

At the Nebraska Electrical Association convention, May 7, Mr. J. R. Cravath gave a talk on the above subject. The following are some of the principal points he brought out.

It seems almost unnecessary to say that good, reliable service at all hours of the day when lighting is needed and good, steady voltage to avoid fluctuation of light are essential when meeting any kind of competition; yet, as a matter of fact, poor service has no doubt been responsible for much of the gasoline competition which has sprung up. All central-station men, he said, are familiar with the drawbacks of gasoline, such as the danger, heat in summer and the nuisance of taking care of the gasoline plant. The talk was, therefore, confined principally to illuminating engineering and the business policy and rates necessary to meet this competition.

As to the illuminating engineering part, he considered only the use of the tungsten lamp, because that lamp was so much more efficient than any other electric lamp suitable to store lighting. With tungsten lamps properly installed, the average illumination delivered on the plane of the counters in a store could be made double that with the best possible arrangements of enclosed arcs or Gem lamps, with a given expenditure of electrical energy. However, gasoline is such a cheap fuel that even the tungsten lamp may fail in competition if its introduction is not accompanied with proper illuminating design and with diplomatic business policy.

He then sketched on the board the light distribution of an up-



FIGS. 1 AND 2.—DISTRIBUTION OF LIGHT WITHOUT AND WITH REFLECTOR.

right gas-mantle burner or the tungsten lamp used without reflector, as compared with tungsten lamps equipped with bowl reflectors and concentrating reflectors. As gasoline lamps and gas arcs are most frequently used without reflectors, a typical distribution of light from such lamps is indicated by the sketch Fig. 1, from which it is seen that a large portion of the total light flux is given off horizontally to the sidewalks, where it is reflected back and forth with great loss before it reaches the plane of the counters. Of course, considerable light is needed on the sidewalls and ceilings, but the average gas, gasoline or tungsten lamp without reflector would waste considerably more on the sidewalls than necessary.

The average customer on entering a store judges the illumination largely by the comfort with which he can see the goods at or near the counter level. He is also influenced by the generally cheerful appearance of the store, but no amount of light expended on the high sidewalls can make up for poor illumination at the counter level. The study of the central-station men when installing tungsten lamps under competitive conditions should, therefore, be to direct a considerable percentage of the total light from a lamp directly to the counter level from the lamp or reflector surrounding it, instead of attempting to get so much by reflection from high sidewalls. To accomplish this, reflectors should be selected which will deliver a large percentage of the total flux of light from a lamp within an angle of about 70 deg. from the vertical, as in Fig. 2. Of the common reflectors which would accomplish this, he recommended the prismatic-bowl type and the deep concentrating prismatic types. He said that a similar distribution to that obtained from the prismatic bowl, shown in Fig. 2, was afforded by the fluted opal cone and the plain opal dome, which are staple articles of glassware for

16-cp lamps. Unfortunately, manufacturers of opal glass have not up to the present time awakened to the lamp situation, so that opal reflectors of sufficient size for tungsten lamps are not on the market, although they are much needed on account of the blinding brilliancy of the tungsten lamps, which needs a good reflector to cover it. With the prismatic bowl reflector, various tests have demonstrated that with tungsten lamps about 65 per cent of the total light generated should be obtained on the working plane of the counters, provided the lamps are not hung so that too large a proportion of the flux of light strikes dark sidewalls.

Small stores he divided into two general classes: First, those which are 15 to 20 ft. wide, with a row of electric outlets down the whole length of the middle of the store. Such a condition is frequently found where enclosed arc or Nernst lamps have previously been used. Second, those 20 or 25 ft. wide, or more, which have two or three rows of incandescent lamps suspended from drop cords. The first class, indicated by the sketch, Fig. 2, is best served by single tungsten lamps or clusters placed in bowl reflectors near the ceiling, the bowl reflector giving a distribution as roughly indicated by the lines in Fig. 2. The second class of store, where lamps are hung over each row of side counters, is best served by the use of concentrating reflectors over the tungsten lamp. In such an event it is not as necessary to place the lamps high as in the first case, but they should not be less than 8 ft. to 10 ft. from the floor. The concentrating reflector used should be deep enough to cover the lamp well.

The usual so-called concentrating reflectors over the Gem lamps do not cover the lamp as much as is desirable. The lamp filament is too much exposed to the eye, and the percentage of light directed below 70 deg. from the vertical is no greater than with the bowl-type reflector, which gives a fairly wide distribution.

Before placing an installation of tungsten lamps in a store where gasoline has been installed, it is well to talk to the prospective consumer a little as to what really constitutes satisfactory illumination for his customer. The average small merchant, when judging of the relative merits of systems of illumination, is prone to look at the light sources themselves, rather than at the general appearance of the store and of the light obtained on the goods. The merchant should be educated to judge his illumination just as would a casual customer of the store who thinks nothing about the lamps, but is simply impressed by the general effect and the comfort with which he can see what he is purchasing. If merchants would do this, there would not be so much demand for blinding, glaring lights in the ordinary line of vision.

COMPARISON OF VARIOUS GAS AND TUNGSTEN LAMPS.

Lamps and equipment.	Total lumens without reflectors.	Lumens effective on counter level.	Lumens effective on counter level.
Gas arcs, average of two kinds, with alabaster globes, 19 to 22 cu. ft. per hr.	2,514	45%	1,131
Upright gas mantle burner, clear chimney, 3.7 cu. ft. per hr.	790	45%	355
Inverted gas mantle burner, C. & L., clear globe, 3 cu. ft. per hr.	679	55%	375
Tungsten 100-watt, with clear bowl reflector	785	65%	510
Tungsten 60-watt, with clear bowl reflector	471	65%	306
Tungsten 40-watt, with clear bowl reflector	314	65%	204

With this preparation, the central-station man is ready to make tungsten installations in stores where gas or gasoline have been used, and in this connection he must know about how many tungsten lamps of a given size properly equipped must be installed to give an effective illumination equal to that previously obtained from gas burners as ordinarily used. The accompanying table was presented to show approximately the results which may be expected. For convenience in calculation, the English candle-lumen was used as the unit of comparison. One lumen is the amount of light required to illuminate a surface 1 ft. square to an intensity of 1 foot-candle. One foot-candle is the illumination on a surface 1 ft. distant from a light of 1 cp with the surface at right angles to the ray of light.

He explained that it is difficult to obtain tests on gas and gasoline mantle burners because of the exceedingly variable conditions of pressure and adjustment and variations in quality of gas which prevail in actual practice. The glassware used also has a great effect on the useful illumination. The gas-burner figures in this table were made from tests made under laboratory conditions on New York City gas by the Electrical Testing Laboratories, for use in Cravath and Lansingh's "Practical Illumination," adjustments being made by manufacturer's representatives. Probably the results were better than ordinarily existed in practice. The alabaster globes used on the gas arcs were those most commonly found on these appliances. The individual burners were tested with clear chimneys without reflectors, this being probably the nearest average condition of actual use. In the case of the gas arc and the upright gas-mantle burner, 45 per cent of the total light generated is estimated in the table as being effective on the level of the counters. The percentage of light given below 70 deg. by these upright gas burners was considerably less than 45. In fact, only 45 per cent is thrown below 90 deg., or below the horizontal, but to compensate for this the large percentage of light thrown horizontally and upward will cause a larger percentage to be reflected from walls and ceilings than if an efficient reflector were used, so that the percentage thrown below the horizontal rather than the percentage thrown below 70 deg. is taken in the case of the upright gas burners. In the case of the inverted gas burner, however, which throws a smaller percentage to high sidewalls and ceilings, no such allowance is made for reflection from walls and ceilings. It is considered on about the same basis as the tungsten lamp with bowl reflector. From the column in the table entitled "Lumens Effective on the Counter Level," the central-station man can get an idea of the number of tungsten lamps required to replace a given number of gas burners. For example, in small towns where gas service is not very good, two 100-watt tungsten lamps could safely be put up to replace a gas arc, while in cities where the gas-arc service is more closely looked after, some companies are using four 60-watt lamps to replace a gas arc. The table is intended to err on the side of safety as far as the central-station man is concerned, because usually the gas burners will not be in as good condition as the table shows. The depreciation of the candle-power of the tungsten lamp with age is not likely to be nearly as great as with gas-mantle burners.

With tungsten lamps efficiently installed, it is safe to count on obtaining an average of 4 foot-candles illumination on the plane of the counters for every 1 watt per square foot expended in electrical energy. With Gem lamps similarly equipped, an average of 4 foot-candles would be obtained with 2 watts per square foot. With common carbon lamps without reflectors, hung in rows over the counters, about 4 watts per square foot to produce an average of 4 foot-candles illumination would probably be required. The use of tungsten clusters with reflectors which allow a large amount of light to escape horizontally and which do not cover the filaments so as to protect the eye from the blinding glare, should be carefully guarded against. They are both inefficient and blinding. Such reflectors can be made unobjectionable and efficient if the manufacturers will only equip them with the proper deep reflectors.

RATES AND BUSINESS POLICY.

Much gasoline competition is due to faulty systems of rates. The man who puts in a gasoline plant or uses gas for the sake of economy is likely to be the man who is using light several hours every evening. If the system of rates is such that these long-hour consumers must pay the same rate as short-hour consumers, it is unjust either to the company or to the long-hour consumer. Assuming that the rate is correct for the short-hour consumer, it is much too high for the long-hour user, and his bills will be so high that he is tempted to put in a gasoline plant or use gas if he can get it. The system of rates should be such as to give the long-hour consumer the lower rate to which he is entitled. This does not mean that any special rates are to be made. Special rates mean discrimination and trouble for the

company making them. If a company finds that conditions are such that it cannot make the proper rate on long-hour business without breaking its rate schedule, it should by all means revise its rate system at once. The rate system of a company should be sufficiently comprehensive so that it will provide for all cases which come up and give a tolerably fair rate to all classes of consumers without the necessity for any special rates. If a company's rate system does not do this, it is high time that it be revised. Among the commonest methods of charging which give the long-hour consumer the low rate to which he is entitled without making the rate too low for the short-hour consumer, there are the two-rate system and the Doherty system. Under the two-rate system the consumer is charged at a high rate for a certain number of hours' use per month of his maximum demand or connected load, while for all over that amount he pays at a very low rate. Under the Doherty readiness-to-serve system, the consumer pays a fixed flat rate of about 15 cents per 50-watt lamp connected, plus $1 meter and service charge, plus the low rate of 5 or 6 cents per kw-hour.

PLANS FOR INTRODUCTION.

When introducing tungsten lamps to supplant existing gas and gasoline installations, the easiest and best plan is to sell the consumer the lamps, reflectors and wiring outright for cash, if this can be done. There are many places where this cannot be done, however. The consumer may be skeptical as to the results he will get. He may recently have been to some expense for a gas or gasoline installation and may not wish to change. He may also be suspicious as to the life and renewal cost of the expensive tungsten lamp. To allay the customer's fears as to the renewal costs, the maintenance-insurance plan is good. Under this plan the company will either sell the consumer tungsten lamps at cost for renewal purposes, or will maintain a customer's tungsten lamp installation for 3 cents per kw-hour. In this way the consumer takes no chances on cost of lamp maintenance, unless he prefers to buy his own renewals.

There may be some customers, however, who will not even consider the initial cost of wiring and lamps, either because they cannot now afford to pay that amount of money out in a lump sum, or because of doubt as to what the installation will do. In such cases, if the consumer is a good one to obtain, both as to credit and monthly income, the company can safely put in a complete trial installation of tungsten lamps, either to be paid for in a lump sum or in monthly installments. In such cases, the company will also usually have to maintain the lamps at a fixed rate per kw-hour.

Another plan of maintenance being tried by some companies is that of having a fixed rate per month. This has the disadvantage that the number of hours the consumer uses his lamps per month cannot always be estimated in advance. Another plan being pushed actively in Chicago is to put in tungsten clusters consisting of four 60-watt lamps on a flat rate of $1.15 a month, burning from dusk until 10 p. m., five nights per week.

The company turns on and off these clusters just as it does the numerous signs which it has on flat rate, the sign patrolmen looking after the switching of the tungsten clusters. The company maintains lamps and furnishes the clusters, the contract being made for two years, so as to spread the cost of the cluster out over that period.

In conclusion it may be said that the tungsten lamp has put the central-station industry in a position where it can make rapid progress in getting business which heretofore has gone to gas or gasoline.

Tungsten Versus Gasoline at Holdredge, Neb.

Mr. F. J. Schwengel reported at the Nebraska convention that the Holdredge Lighting Company, of which he is manager, had put out 200 100-watt tungsten lamps. In the week before convention, tungsten lamp installations had replaced three gasoline-lighting outfits and there were more to come.

The Motor-Driven Centrifugal Pump as a Central-Station Load.

BY E. N. PERCY.

No pump is more ideally adapted to use with the electric motor than the centrifugal pump, and a proper exploitation of this kind of pump can considerably increase the motor sales and energy output of central-station companies. Since the invention and development of the multi-stage and turbine-type centrifugal pumps, there is hardly any duty or pressure to which they are not better adapted than the reciprocating pump, when electrically driven.

Where long transmission lines cross the country there is frequently opportunity to develop small irrigation projects by pumping from some lake, stream, spring, well or canal and greatly enriching the value of adjacent land, whether already farmed or not. Where the capital cannot be raised to build a proper canal scheme, irrigation can frequently be accomplished to great profit by each farmer putting in a small pump and attaining all the results desired. The writer has seen 160 acres of desert land bear four fine crops of alfalfa per year when irrigated with a 4-in. pump and 7-hp engine pumping from an alkali lake, the water being lifted about 15 ft. A 75-hp engine, driving a 12-in. pump, lifting water 15 ft. from an alkali lake, irrigated 1500 acres, upon which four crops of alfalfa were raised per year. If a transmission line had been run across this country, much of the energy could have been sold along the 30-mile length of the lake.

Other purposes to which motor pumps are applied include municipal fire and water service. In small towns the pumps run in parallel for ordinary service, but in the event of a fire are connected in series and give double the pressure. A particularly good point about these pumps is that if the discharge valve is closed, no harm results, as the pressure does not increase.

Fire pumps driven by motors have been approved by the underwriters for certain conditions, and in places where a constant pressure is to be maintained, as with properly wound motors, they run at constant speed, whether discharge valves are open or shut, and the load varies approximately according to the amount of work used. If all valves are shut, the pressure is maintained just the same.

Frequently it happens that contractors wish to keep a foundation, caisson or other piece of construction drained. A vertical centrifugal pump submerged in a sump, connected by a vertical shaft leading to the motor placed high and dry, makes a fine combination for such purposes. Also, for land drainage or reclamation on a large scale, such as marshes, lake bottoms, flooded islands, etc., the electric pump would often find a ready sale if someone were right on the spot with the electricity and motor and pushed the proposition. For instance, parts of the Sacramento River District in California, especially islands in the river, are frequently flooded. They are always reclaimed with huge steam-driven centrifugal pumps, notwithstanding the fact that the largest long-distance transmission power lines in the world run up and down and all around the river. Some of the pumps have 48-in. discharge openings and immense capacity; in addition there are hundreds of small pumps used by small farmers for draining land and gardens.

The small gardener, especially the progressive Italian, can always be shown where a small electric pump will leave him free to do other work, and cost less than a windmill or tank.

In large buildings, of late, it is a custom to put in complete plumbing for ice water, pumped from the engine room to a tap in each room. The centrifugal pump is again very suitable, because no floats, governors or other automatic apparatus are necessary. The pump maintains the circulation and supplies all water drawn, without regulation of any kind, damage to pipes or noise; nor is it necessary to have an air chamber. Needless to say, the electric motor is the ideal drive, not only because of its noiselessness, but it costs less to operate and to repair than the reciprocating type of pump.

For tank service, the motor-driven centrifugal pump is ideal,

because, instead of a complicated and unreliable automatic apparatus to shut off steam or electricity when the tank is full, a plain float valve is put on the end of the discharge pipe, and when it closes, nothing happens. The pump runs right along, taking scarcely any power, until the valve opens again. If this continues for some time, it will be observed and the motor can be shut down by hand, which is usually the case anyway.

In large power plants, the centrifugal pump has a recognized place as a feed pump. A three- or four-stage pump, operated by an electric motor, will feed the boilers through any length of pipe without an air chamber, and there will be no noise, shocks, jars or other trouble incident to a high-pressure reciprocating type of pump. Any or all of the checks may be open or closed; the pump will need no attention. In the event of a sudden shut-down of the main engines, all checks may be opened wide and the boilers flooded with cold water; the pump will run just as it does under no load, and the gages show little or no variation of pressure.

Its use as a circulating water pump or as a fire pump has been well established. It is probable that future circulating pumps will, in some instances, be electrically driven and run at much higher speeds; being, in consequence, smaller. As a water service pump for tall buildings, the same advantages apply. There is, however, an additional advantage. In modern office buildings, the lower stories have a much too high pressure, in some cases 200 lb. per square inch. To offset this it has been customary to pump to a tank on the roof, and to use reducing valves for the lower stories, or to have several systems of piping running at various pressures. With the centrifugal pump an electrically-driven pump could be placed every two or three stories, maintaining a very medium pressure, and would run unattended for days at a time. In the event of their stopping, if no check valve is at the suction, no pressure could accumulate and the pipes would simply empty. A multi-stage pump could be operated in the engine room with sufficient capacity for the building. From each stage, a pipe could be taken and run as high as that number of stages was supposed to discharge, the last one taking the upper stories.

Many opportunities exist in small and large cities to solve sewage problems by the installation of an electric pump at a suitable point. It must be remembered that a comparatively small pipe can handle the contents of a large sewer, because of the much higher velocity. Often it is necessary to mix water with the sewage. This is a specialty by itself, but an electric pump, and a pipe line to some nearby river, swamp, sewage farm or sump would settle many a perplexing sewage question.

Mine drainage is one of the most profitable fields for the electrical man. If a transmission line be near by, the proposition is ideal. If not, a power plant close at hand, with electrical transmission to the pit, is an ideal and economical arrangement. No attention below ground is necessary, except occasional inspection. No matter whether a sinking pump, station pump or submerged outfit be used, the efficiency is high and no losses from condensation or other troubles due to long steam pipe line are present. In the water discharge, there is no water-hammer, noise or other trouble as with a reciprocating pump. The discharge is smooth, regular and noiseless. Mineral or gritty waters do not hurt the pump, and it will work in any position.

Deep-well pumps for irrigation, general farm supply and even water supply for large buildings are best driven by motors. Any engineer or owner can be very quickly shown how much more economical the electric contrifugal pump is than the deep-well steam pump generally in use, and the first cost is usually less. This type of centrifugal pump is fairly well developed. It is the best pump for fountain service, as many a pretty park and public square could be graced by a fountain were it not for the cost of the water, and any ordinary means of pumping the same water over and over entails an attendant with consequent expense. The little electric centrifugal will maintain this service, with a small expenditure of energy, and almost no attendance. The city of Berlin, Germany, has many such fountains. In isolated, unattended stations of all kinds. such as railroad tanks, long pipe lines, filling flumes, etc., this type of pump can be placed and left, with reasonable assurance of its continuous operation.

Electric centrifugal pumps are now being used on board ship for drainage, fire service, bilge and deck use. In addition to the advantages mentioned before, they are unaffected by dirty water, coal, ashes, waste and other débris which may gather in the bilges in time of storm, and always result in shutting down an ordinary reciprocating pump at the critical moment. Some hydraulic dredges have been built with electric motors instead of a steam plant, where electric power was especially available; and several have been built with electrically-driven auxiliaries.

Systems for handling lubricating oil for large plants can be handled with least danger to pipes and drip points with a centrifugal pump. They are found in such places as breweries for handling beer, rubber factories to pump the solutions filled with rubber lumps, chemical factories and oil refineries. In ice plants they have been used with the greatest success for brine pumps and for circulating water through ammonia condensers. The pump is well adapted to the open-air style of ammonia condenser, pumping from the pan over and over, with just enough added to make up for evaporation, as the water runs down over the pipes in the open air.

The hydraulic elevator field is one of the finest for this type of pump. Its peculiar advantages make it particularly applicable to elevator service; especially as, while electric power is usually available, many engineers prefer hydraulic elevators. With the electric centrifugal pump one has the hydraulic quietness and certainty of control, with the simplicity of the electric motor, without gears, clutches, brakes, pump plungers or other complications attendant upon either the hydraulic system with reciprocating pumps or the direct electric system. With the electric centrifugal pump system, the control is simple, while the motor is continuously running and not subject to the exigencies of indirect control. Furthermore, such starting and stopping apparatus as is necessary is under the eye of the engineer, and is very simple. This system has been worked out practically by well-known elevator firms. The wide field for the electrically-driven centrifugal pump is therefore apparent and it rests with the electric light companies whether or not full advantage will be taken of the opportunity for a motor load thus presented.

Electrical Shows.

By H. W. Hillman.

So much has been said and written about electrical shows that those associated with the electrical industry perhaps have the impression that the electrical show is now an old story. This impression may have been received because we are inclined to become so interested in our own work that we fail to weigh carefully the impressions of those associated with other industries and the people in general.

It is not true that the electrical show has become an old story. It is brand-new, and even Chicago and New York have practically just started the idea. I believe Grand Rapids is the first city as small as 100,000 population to have an electrical show. The great success from what might be called an experiment has led me to the opinion that every city and town in the country, regardless of size, should have an annual electrical show. The central station should be the leader and interest supply dealers, contractors, manufacturers and the people to support the enterprise.

Many central-station managers may think their city or town is too small to be able to follow Chicago and New York with an electrical show. For the benefit of such station managers I will offer the following suggestions, hoping that they may be of some value to them on this subject.

The size of the city or town does not interfere in the least. It simply limits the extent of the exhibition. The fact that a town is large enough to have a central station is sufficient to warrant an electrical show. Opportunity is afforded to beautifully exhibit all the various electrical devices even in a small

hall. If the size of the town demands a small hall and small exhibit, the effect is to create small initial and operating expense, a feature that encourages instead of discourages the idea of the exhibition.

At Grand Rapids the two competing telephone companies exhibited with 400 sq. ft. of space for each company. Their exhibits were especially attractive to the people, and their managers have advised me since that even though they did not secure enough additional business to pay for the space and operating expenses, the educational feature was one which warranted them in exhibiting.

The electrical show differs materially from food shows and is more educational and more valuable because the devices interest men, women and children, those associated in stores, factories, libraries, offices and in all walks of life.

A prominent citizen and manufacturer advised me regarding the Grand Rapids show that he thought it was wise to charge an admission of 25 cents because the people, having paid this admission, would pay more attention to the exhibits and spend more time than they would providing the admission were free. Inasmuch as the exposition is for educational value, this point is well taken.

During the show teachers of the schools sent boys as representatives to investigate the various devices and to speak before the other scholars advising them in regard to the many attractive features. Thousands of tickets were distributed among the schools, with permission of the school board, and a large attendance of children resulted at an admission of 10 cents each.

The electrical show in Grand Rapids was particularly appropriate at this time because of the rapid development in connection with incandescent lamps. Manufacturers and supply dealers had beautiful exhibits of tungsten lamps with all kinds of shades, and their presentation of the latest methods in electrical illumination was highly educational. I know that the people appreciated such exhibits because many of our manufacturing customers advised me of their intention to test the new tungsten lamps in their factories. The manager of the city schools was particularly interested because they are considering particularly the wiring of many new buildings and the best methods of lighting schools. He is considering the use of the vacuum cleaner in the high school for an experiment. There is a feeling here in the city that schools should be cleaned oftener, that the dust from blackboards is injurious, and the adoption of the electrical vacuum cleaner or renovator is being very carefully considered for schools. This exhibit is valuable in the form of an exposition because school matters are always discussed in the newspapers, and physicians are particularly interested in sanitary features of schoolhouses. Therefore, if an appropriation is made for vacuum cleaners the people will be more likely to support the idea, having been impressed with the advantages of the device at the electrical show.

The show can be made self-sustaining if it is properly handled. An electrical show association should be formed, including the central station, the supply dealers, the contractors and any local manufacturers; or, if thought best, limited to the central station and supply dealers. The very first work in connection with exhibits requires a contract with the supply dealers to do the wiring, and then the exhibitors furnish the supply dealers work for wiring. As a result the expense for space of the supply dealers is more than returned by their contracts for wiring work. The central station secures a return of its money from the light and power meters installed in connection with the exhibits, the manufacturers are able to secure a return for their space money by watching the requirements of the central station and the dealers and contractors for materials for use in the exposition. At the Grand Rapids show a local sign manufacturer had 15 beautiful signs on exhibit, all of which had been sold and were ready for installation immediately after the show. Various orders were taken at the show for signs because of the exhibit. Therefore, the manufacturers secured a good return for the small expense involved.

Regarding charge for space, the Electrical Show Association had no difficulty whatever in securing 50 cents per square foot. The association employed an architect who presented a general design of the decorations and booths for the inspection and approval of the executive committee of the association. All aisle decorations, wooden supports, railings, arches, painting and illumination for them were handled by the association for the purpose of having uniformity in appearance. This policy offered an opportunity also to reasonably charge 50 cents per square foot for space.

A concluding point, which should strongly impress every station manager, particularly if one can assume that all station managers are desirous of increasing their business, is that in order to hold an electrical show it is necessary to have the hearty co-operation of the central-station manager, the supply dealers, the contractors, the people and the local manufacturers. They must all be pulling the same way and endeavoring to help one another, and co-operating with one another for the improvement of the local electrical business. Such a situation is cemented by the holding of an electrical show, and it is helpful throughout the remainder of the year in ways too numerous to relate. If hearty co-operation does not exist between the parties mentioned, and a station manager desires to hold an electrical show, he will find it necessary to change relations, making them pleasanter and more co-operative. Therefore, a study of the electrical show and the necessities for the success of such a show will require a change in the policy to the effect of heartily co-operating with dealers, contractors and local manufacturers, and a situation will be brought about which will not only mean success for the electrical show, but it is the keynote to the success of central-station business. I have always believed in the hearty co-operation of such parties interested in the electrical industry locally as well as the people, but the electrical show in Grand Rapids has impressed upon me more than ever the great value of co-operation.

LETTERS TO THE EDITORS.

Patent Office Models.

To the Editors of Electrical World:

SIRS:—The technical press of the country is the direct result of modern invention, and it should properly constitute the forum wherein the inventors may express their opinions and confer as to their needs. The need for common discussion and action on the part of the inventors was never greater than at the present time, as has been set forth by contributors to your columns.

At the present time the Patent Office has a surplus of nearly $7,000,000 to its credit, and last year its surplus amounted to over $279,000. In the face of this enormous excess it is calmly proposed in the name of economy to dispose of the patent models by public sale and removal to the National Museum, where they do not belong. These models, numbering over 157,000, constitute the greatest mechanical museum in the world, and form an integral part of the patent system of this country. According to Commissioner Moore, of the Patent Office, they are public records, and absolutely essential to the adjudication of questions of priority and invention. Commissioner Moore, in his testimony before the Senate committee, states, and every one connected with the patent business knows it to be true, that many of the old inventions were not disclosed in the original drawings, but are always disclosed in the models.

A bill has passed Congress and I am informed has been signed by the President, appointing the Secretary of the Interior, the secretary of Smithsonian Institution and the Commissioner of Patents a committee of three to determine which of the patent models the inventors need and to dispose of the remainder by sale or otherwise. The absurdity of this bill is at once evident. Who is competent to say what the inventors of to-day need? By what rule are we to measure inventive

needs? Who is to formulate a philosophy by which the future course of invention, science and industry is to be determined specifically in advance? Solomon is dead and Franklin, if living, would ridicule the task; who can understandingly accept it? A running brook may suggest to the poet a rhyme; to the painter a landscape; to the engineer power; to the agriculturist irrigation; to the inventor perhaps an endless belt, perhaps a new mixer, perhaps a new drill, perhaps a new tool that bears no relation to natural scenery. By what means are we to learn the value of the patent models in suggesting new inventions; can three men who are crowded with their work competently decide the value of the 157,000 models to invention, to art, to science and to industry?

But more important than this phase of the question is the purely legal aspect of the proposed destruction of the Patent Office models, the proposed assault on the integrity of the patent system and the validity of existing patent rights. Since the Patent-Office models are vital public records of current value to the Patent Office it follows that their destruction, by removal to quarters where they will be practically inaccessible to public and official inspection, or by sale or gift, will operate to confuse the work of examination, prevent the body of inventors from learning the nature of expired patents in order that they may intelligently use or avoid them, as necessity requires, and result in endless fraud.

Little has been heard of the proposed disposal of the models, perhaps for the reason that the patent lawyers desire their disposal, and the corporations will benefit by this disposal. It practically means the records of inventors are no longer safe in the hands of the government and that it is as likely to dispose of or neglect to protect the files of the Patent Office, which constitute the greatest technical library in the world to-day, and that a large number of inventions covered by the models, and not shown in the patent drawings, will be repatented, thus contributing to the rapid demoralization of the entire patent system.

For the last 10 years we have been approaching a crisis in the patent system, and it seems that the critical period has at last arrived. In operation the patent system is becoming ever more inimical to the inventor and ever more unreliable, complicated, confused. Thought should precede discussion, discussion should precede action, and action should correspond with need.

Nothing can be done without concerted action, and this can be best accomplished by organization. Invention has organized the world, but the inventors are the most poorly organized class of citizens in the world. Every class of citizens is organized, from the chicken pickers to the philosophers, from the undertakers to the ministers, all except the most useful class, the inventors.

Invention is the product of need consciousness. Organization is the highest expression of need. Let the inventors organize! The time to begin is right now. The way to act is directly. The exact plan is immaterial. The name important, but not vital; here is one that has already done valiant work in Washington—The Society of American Patentees and Inventors.

Let the inventors of every locality confer and form temporary organizations, let them begin now to amass and develop power to influence legislation. Temporary organizations should first be formed, and then a general conference should be held of representatives of different cities and a national organization, with international branches, formed. There is work right now to be done. The integrity of the Patent Office must be maintained. The validity of patent rights must be secured. The progress of invention must be rendered more certain, and more beneficial to the inventor. The progress of society depends on the progress of invention, and the progress of invention must no longer be left completely in the hands of men who are incapable or not desirous of securing to the inventor his constitutional and social rights.

The inventors and scientists everywhere should forward an immediate protest to the President and the secretary of Smithsonian Institution against the sale, removal or disposal of the models.

These protests must be forwarded immediately, organization should proceed at once. Let every prominent inventor select a few friends and induce them to join with him in an organized effort to conserve the interests of the American inventors and patentees. The immediate aim of organization should be the preservation of the Patent Office models; the ultimate aim should be as broad as inventive need and contemplate broad reforms of an enduring character. The writer will do all in his power to co-operate in securing efficient organization of inventors and patentees.

Washington, D. C. Joseph J. O'Brien.
615 Sixth Street, N. W.

[We are thoroughly in accord with our correspondent as to the desirability of a national organization of inventors, but we believe that he overrates the value of the collection of Patent-Office models. For about a generation it has been optional with an examiner to require a model, and this option is very rarely exercised, except in cases of an application for a patent on a perpetual motion or other machine involving denial of a law of nature. The present collection, with few exceptions, thus dates back 30 years or more; and only a small portion of it is now available for inspection by inventors, the greater part being boxed and stored. Presumably the models to be preserved are those of interest in the history of the various arts involving invention, and in the selection of these the committee without doubt will have the assistance of the staff of Patent Office examiners, who are necessarily experts in the history of these arts.—Eds.]

Choice of Transformers.

To the Editors of Electrical World:

Sirs:—In his article on "The Choice of Transformers for the Central Station," in your first issue for May, Mr. L. A. Starrett assumes that 110-volt incandescent lamps may operate at from 111.65 to 111.76 volts for 4 hours out of each 24. Under ordinary lighting conditions it is not usual for all lamps to be in use when the e.m.f. has the high value indicated. In order for the life of the lamps to be decreased from 600 to 441 or 447 hours, as stated by Mr. Starrett, they must be used during their whole life at the no-load e.m.f.—which condition is an impossible one in practical service.

Moreover, the value of 18 cents for each incandescent lamp seems high, as does also the rate of 15 per cent on the investment. Furthermore, it does not seem plausible that a transformer operating at a high temperature should last as long as one operating at a lower temperature.

Follansbee, W. Va. J. G. Homan.

To the Editors of Electrical World:

Sirs:—The electromotive forces mentioned by Mr. Homan, namely, 111.65 and 111.76 volts, are the no-load values for transformers that operate at a full-load e.m.f. of 110 volts. In the latter part of my article it was stated that "not all of the lamps would be in use when the voltage was at the higher point." In any event, however, the lamps are used at e.m.f's. above the normal value.

The value of 18 cents per lamp covers not only the cost of the lamp, but also the time and expense necessary to replace it. The value of 15 per cent interest on the investment is not net but gross, and covers all points usually included in this item.

In regard to the operation of transformers at high temperature, Mr. Homan evidently overlooked the statement in my article that "the temperature rise is not a vital point because the transformers operate at full load for only a small part of the time." Naturally the 20-hour temperature of the transformer will be that due to the transformer iron loss only, and the operating temperatures of the transformers, namely the high-efficiency and low-efficiency types, when subjected to iron loss only do not differ materially. If the low-efficiency transformer were operated continuously at full load, it would naturally deteriorate more rapidly than the high-efficiency transformer.

Pittsburg, Pa. L. A. Starrett.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Voltage Regulation for Alternators.—M. SEIDNER.—Modern alternators with a voltage drop of from 15 to 25 per cent fulfill all requirements of practice, so that with such alternators there is really no necessity for employing a special method of voltage regulation. The author thinks, however, that in future the tendency will be to build alternators with from 30 to 50 per cent voltage drop because they are much cheaper, and then to employ a special method of voltage regulation. The various designs of voltage regulators which have been invented in the past are classified and briefly described. The author describes a new regulator of his own. The special feature is the use of an iron resistor, such as is used as ballast resistor with Nernst lamps. Its property is to regulate for constant current within

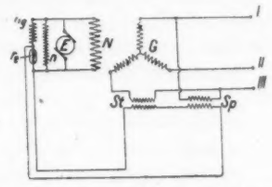


FIG. 1.—VOLTAGE REGULATION FOR ALTERNATORS.

certain limits of potential difference. By raising the potential difference at the terminals of an iron resistor the latter is brought from dark red heat up to bright red heat, and its resistance increases simultaneously in such a way that the current remains practically constant within these limits: If direct current and alternating current passes simultaneously through the iron resistor, the latter maintains the "geometrical" resultant of the two currents constant. If one current increases, the other diminishes. The principle of his voltage regulation is to pass through the iron resistor both the exciting direct current of the generator and the alternating current of the line. Any changes in the alternating current cause corresponding changes in the direct exciting current whereby the voltage variations of the generator are compensated. The first arrangement used by the author is shown in Fig. 1. *G* is the

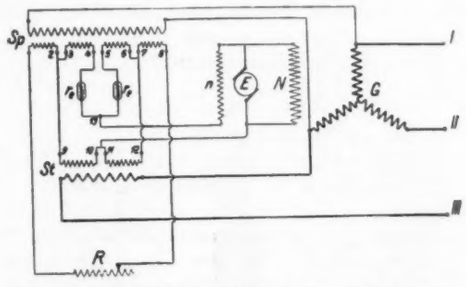


FIG. 2.—VOLTAGE REGULATION FOR ALTERNATORS.

armature of the three-phase generator and *N* are the field windings which are supplied with direct current from the exciter *E*. The exciting circuit n_g contains the iron resistor r_e the terminals of which are also connected to the series transformer S_t and the shunt transformer S_p. Both direct current and alternating current pass, therefore, through the iron resistor r_e. Since with increasing load in the line the alternating current in r_e increases, the direct current will decrease. It is, therefore, evident that the exciter must be provided with a double winding, namely, with a magnetizing winding n and a demagnetizing winding n_g. The current in the latter is regulated by means of the iron resistor. Experiments has shown that such a differential excitation is unstable. The author, therefore, connects the two transformers so that their voltages are added under an angle larger than 90 deg. With increasing current the resulting voltage does not increase but decreases, which causes a decrease of the resistance of the iron resistor and results in an increase of the direct current. The iron resistor, therefore, regulates in the correct direction, with only one set of magnetizing winding. The arrangement of Fig. 1 has other disadvantages due to the fact that r_e, E and N are in parallel so that the alternating current exists not only in r_e, but also in the armature and the magnet-field coils. Similarly the direct current of the exciter enters into the secondary windings of the transformers and magnetizes them in one direction. To overcome these disadvantages the arrangement shown in Fig. 2 is now used. The rotation is the same as in Fig. 1. This method of voltage regulation is stated to be simple, cheap and absolutely safe in operation, and it can be applied to completed machines.—*Elek. Zeit.*, April 30.

Operation of Alternators in Parallel.—L. FLEISCHMANN.—The author criticises some objections which have been raised by Benischke against the formulas of Goerges and Rosenberg on the resonance phenomena of alternators. He also criticises a few fundamental points in Benischke's own mathematical theory. He concludes that the old theory has been found useful in so many cases that it is best under all circumstances to try to avoid any resonance which would occur according to the old theory.—*Elek. u. Masch.*, April 19. Benischke's and Fleischmann's replies in *Elek. u. Masch.*, April 26.

Parallel Connection of Alternators.—G. BENISCHKE.—While it is in general true that parallel operation of alternators, driven by reciprocating engines, is usually best accomplished by belt-driving, he describes two cases in which the belt driving rendered the parallel operation impossible. In both cases surgings occurred which were due not to oscillations of the electric machines themselves, but to impressed oscillations. In one case the lack of degree of uniformity of the rotative speed of the driving engine was too great, and the only remedy would have been to increase the weight of the fly-wheel. In the other case the trouble was due to torsion oscillations of the connecting axle. In both cases no remedy was tried and the alternators were not operated in parallel.—*Elek. u. Masch.*, May 3.

Lamps and Lighting.

Metallic-Filament Lamp.—An illustrated description of a new metallic-filament lamp of English make which, as already mentioned in the Digest, consists of a number of 20-volt to 25-volt tubular-unit lamps grouped together on one holder to form a 100-volt or 200-volt lamp. Each of the tubular lamps contains a substitutional resistor and a simple switching device, so that if one of the tubes burns out the others are not extinguished. Each of the low-voltage tubular lamp units costs about 25 cents, and, although the first cost of the whole lamp with its body is greater than that of the ordinary metallic-filament lamp, it is estimated that the cost of renewals will be far less, since these comparatively heavy flawless filaments will have a longer life and when one unit fails, only this one need to be replaced. The substitutional resistor is simply a short carbon filament within the lamp itself, as shown in Fig. 3, in which the metallic filament is marked *M* and this carbon filament *C*. The carbon filament is connected in parallel with the metallic filament through a miniature spark-gap, contained in the lamp cap and consisting of two small pieces of metal, separated by two layers of an insulating material resembling tissue paper. The insulating material keeps the carbon filament out of circuit normally, but when any lamp tube burns out the potential across the spark gap rises from a value of 20 or 25 volts to the full 100 or 200, the insulation is punctured and the two pieces of metal are fused together making a circuit through the carbon filament. This latter has the same resistance as the metal filament, so that the same current as before continues through the remaining

lamp tubes. The specific consumption per British candle-power is given as from 1¼ to 1½ watts. The 20-volt tubular lamp gives about 10 cp and a group of 10 on a 200-volt circuit will give 100 British cp with a consumption of from 125 to 140 watts.—Lond. *Elec. Eng'ing,* April 30.

Metallic-Filament Lamps and Central Stations.—An account of the continued discussion of Handcock and Dykes' recent paper on the effect of the new metallic-filament lamps on the business of central stations. C. P. Sparks said that the standard of illumination would be raised, and he did not think the electricity supply business would suffer severely. He expressed disapproval of the maximum-demand system and approval of the flat-rate system of charging. C. H. Stearn exhibited his new multiple-unit lamps (described in a separate abstract). P. Still preferred the flat rate of charging for lighting. L. Andrews cited instances in which the drop in revenue due to the introduction of metallic-filament lamps had been considerable. He thought the flat rate of charging inequitable, and said that good results, both as to consumption and load factor, had been obtained some years ago by charging $2.50 per lamp connected and 3 cents per kw-hour for energy. J. F. C. Snell had found that comparing incandescent gas burners with metallic-filament lamps, gas at 62 cents for 1000 cu. ft. was equivalent to energy at 7 cents per kw-hour. He believes in the flat rate of charging. R. Hammond gave figures showing the increase in kw-hours generated in London during the past few years; he is convinced that the falling off in output will be only temporary, and that the new lamps will be a magnificent thing for the industry. He approves the principle of the authors and Long's system of charging. E. T. Ruthven-Murray said that the power factor of auto-transformers used for metallic-filament lamps is as low as 0.7 on low loads, but rises to nearly unity on full load. He suggested the use of a time-limit indicator with a non-replaceable contact that could be set by the consumer. W. M. Mordey suggested the term "wire lamp" instead of metallic-filament lamp, and spoke strongly against the maximum demand system. (In letters in Lond. *Elec. Eng'ing,* May 7, it is pointed out that the term "wire lamp" is not correct, since with the exception of the tantalum filament, the filaments are not wire drawn, and the term "metal lamp" is put forward as a substitute.) In summing up the discussion, Colonel Crompton took the view that the new lamps would seriously affect some of the central stations, and that a review of the methods of charging is necessary.—Lond. *Elec. Eng'ing,* April 30.

FIG. 3.—METALLIC FILAMENT LAMP.

Tungsten Lamp.—A description of a continuous method of Ruhstrat for making tungsten filaments. A continuous wire of tungsten oxide, etc., passes through an orifice in the press containing the paste and is then conducted through an electric furnace. When it leaves the furnace it is either wound on a roll or cut into predetermined lengths. The continuous speed of the moving wire is about 2 mm per second. The whole apparatus is enclosed in an air-tight vessel through which hydrogen passes.—*Zeit. f. Beleucht.,* April 30.

Graphite Filament.—A note on a method of the Anker Company for making graphite-filament lamps. Chemically pure graphite of low specific resistance is made up with concentrated nitric acid into a paste and heated in a large platinum crucible. To the residue about 10 per cent of a binding material (acetyl cellulose, solutions of pitch or thin coal tar, etc.) is added and the mixture is worked up into a uniform paste, which, by pressing through fine orifices, is formed into filaments. They are preliminarily dried, but before they have hardened completely and have become brittle, they are brought into the desired form, embedded in graphite and heated. Lamps with filaments prepared in this way are said to have a life of from 500 to 600 hours and are said to consume from 1 to 2.5 watts per hefner candle.—*Zeit. f. Beleucht.,* April 20.

Transformers for Metallic-Filament Lamps.—A. Bainville.—The author refers to the design of the small transformers now on the market in England for reducing the supply voltage for use with low-voltage and low-candle-power metallic-filament lamps. He remarks that the design is very nearly the same as that of the transformers used by Weissman for his low-voltage carbon lamp system which was exhibited at the Paris Exposition in 1900. He used carbon lamps at 18 or 20 volts and from 10 to 16 cp, consuming about 2 watts per candle-power and having a useful life of 200 hours. The author thinks that the attempts to produce an efficient 16-cp, 220-volt, metallic-filament lamp will be futile and that the use of step-down transformers is preferable.—*L'Ind. Elec.,* May 10.

Small Transformers for Metallic-Filament Lamps.—An illustrated description of an "adapter transformer" which, as shown in the middle picture of Fig. 4, is connected between the lamp and the switch, so that its employment does not require any alteration of the wiring of the room. The transformer is placed in the lamp socket like any ordinary lamp, and the low-pressure lamp is placed in a socket provided at the lower end of the transformer. A single core of high-grade iron strip is insulated, and first the primary and then the secondary winding are put on. The ends of the strips are then bent round at both ends and both sides to form a closed magnetic circuit. On account of the modern methods of insulation employed in the manufacture of the "adapter transformers," a very high space factor is attained. The continuous rating of the standard type illustrated in the middle figure is somewhat over 20 watts, and the usual arrangement is to use one of these in conjunction with one 16-cp, 25-volt lamp, or two 10-cp, 25-volt lamps. The transformers can be obtained for primary e.m.f's. of from 100 to 250 volts and for a secondary e.m.f of 25 or 50 volts, and for any required frequency. Since an ordinary carbon-filament lamp consumes 3.75 watts per candle and most metallic-filament lamps consume about 1.2 watts per candle, and the efficiency of the "adapter transformer" is 85 per cent, consequently the combined transformer and lamp will consume less than 1.5 watts per candle or still less than one-half of the carbon lamp. At a slight extra cost a turn-down device can be fitted to the transformer. By twisting the lamp socket, the lamp terminals are brought in contact with stationary contacts connected to different points on the secondary winding, as shown in the right-hand diagram. There are, as shown, three positions: (1) 25 volts (full voltage), corresponding to the full candle-power, say 16 cp; (2) 20 volts, corresponding to about 10 cp, and (3) 5 volts, which gives a mere glow suitable for night light in the nursery or sick room. As the transformer is designed to work at full load, the value of the no-load pressure is of no account, and any drop can be allowed so long as the full-load terminal voltage is the proper voltage for the lamp to be used. This

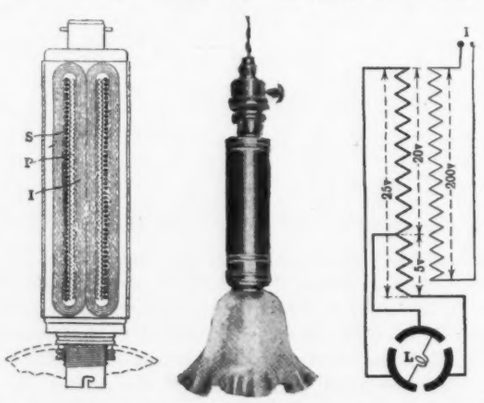


FIG. 4—TRANSFORMER FOR METALLIC-FILAMENT LAMP.

permits of a much more economical design, as the only factor to be considered is the heating of the iron and copper and the losses.—Lond. *Elec. Eng'ing,* May 7.

Leading-In Wires.—Descriptions of various methods for making a joint between the ends of the filament and the leading-in wires. The Allg. Elek. Ges. uses the heating effect of a high-ampere, low-voltage, auternating current, together with slight

mechanical pressure. The current is applied only for from 1/10 to 1/3 second to prevent any oxidation. Kuzel joins the filament with the leading-in wires by means of a very refractory metallic carbide, for instance, manganese, chromium, tungsten, etc., carbide. If the ends of a carbon-filament are put into fused tungsten carbide made by the method of Moissan, the carbide passes into the pores of the carbon and when the filament is removed the end is covered with a layer of the carbide, which may be made of any thickness by repeating the operation. The joint between the nickel end of the leading-in wire and the end of the filament obtained by this method is strong; the same method may also be employed for metallic filaments. The tungsten carbide need not be chemically pure, but it may contain from 1 to 6 per cent of carbon, as in the case with carbide produced by Moissan's method. Other methods of making a joint between the leading-in wire and the filament are also described. —*Zeit. f. Beleucht.*, April 30.

Leading-In Wires.—B. DUSCHNITZ.—An article discussing the production of the joint between the leading-in wire and the surrounding glass. Flint glass (containing lead) and platinum have almost exactly the same temperature coefficient of expansion. The author gives a long review of various proposals which have been made to save the expense for platinum, mainly based on patent specifications, and also discusses the use of two kinds of glass in the same globe.—*Elek. Anz.*, April 12, 16 and 19.—The same author discusses the methods of making the joint between the leading-in wires and the filament, the descriptions being based on patent specifications. Some general discussions are added.—*Elek. Anz.*, April 30; May 7-14.

Osram Lamps for Street Lighting.—Figures collected by P. T. Wilmshurst from actual operation of osram lamps in Derby show an average life of at least 1570 hours. Since a number of the lamps are still burning, their life will be longer, but no account has been taken of this fact in the above figure. The diminution of light up to the end of the life was small in each case. G. Wilkinson gives comparative figures proving that street lighting by osram lamps is much cheaper than by incandescent gas mantles. The comparative figures are as follows:

One 3-cu. ft. gas mantle costs per year for gas	$3.75
Mantle	.37
Total for 1200 hours, burning	$4.12
Electricity at 2.5 cents per kw-hour, for 33-watt osram lamp, which gives an equally good light, and often better than a gas mantle	$2.31
Renewals	.75
Total for 2100 hours, burning	$3.06

As to the life of the osram lamp, Wilkinson states that "this appears to be very satisfactory. They appear to last much longer when used without globes, probably due to the cool atmosphere around them; we have numbers of them in the town burning well on to 3000 hours, and the average is probably over 2000 hours, excepting in case of accidental breakage." —Lond. *Elec. Eng'ing*, May 7.

Nernst Lamp.—In order to avoid the use of special preheating devices for Nernst lamps, the Cons. f. Elektrochem. Ind. mixes the rare earths, etc., with tungsten, or tungsten alloys. The content of tungsten gives the filament the desired conductivity in the cold state. Filaments of this composition must be used in vacuuo or in an inert atmosphere, and the lamps can be operated only with alternating current, since with direct-current, electrolysis destroys the filaments. The lamps must be used with a ballast resistor (iron).—*Zeit. f. Beleucht.*, April 20.

Mercury-Vapor Lamp.—P. A. HUGUENIN.—An illustrated description of his method of starting mercury-vapor lamps. When the switch is closed, an electromagnet imparts to the tube a tipping motion, and, by means of a contact device, a portion of the electromagnet winding is caused to remain in series with the arc and to give the resistance and reactance necessary for the stability of the arc. The system is easily applicable to connection of several lamps in series. Several possibilities of improving the color of the light are also discussed.—*La Lumière Elec.*, April 18 and 25.

Polar Curves.—W. VOEGE.—A translation with illustrations of his recent German paper on a new method of obtaining polar curves of distribution of light or an artificial illuminant. As was noticed in the Digest, the author measures the total radiation in different directions around the lamp by means of a thermo element and reduces the results to photometrical curves by measuring the intensity of the light in one direction and assuming a constant ratio of luminous energy to total energy in all directions.—Lond. *Elec.*, May 8.

Generation, Transmission and Distribution.

Electricity in German Mines.—An article on the large increase in the use of electric motors in mines in the Rhenish Westphalian district and especially in the Ruhr coal district, where the separate steam plants are gradually being superseded by electric power. The generating plant is always located where the cost is a minimum, either at the colliery or at coke ovens where the gases are utilized. A greater distance between the different generating plants offers no difficulty for their operation in parallel and for using one or the other as reserve. The mine companies have begun to supply electric energy to towns in the neighborhood. For instance, the Hibernia Company, which had no electric installation in 1902, has gradually installed a number of generating plants which will have a rating of 20,000 hp during the middle of this year. All the mines are connected together by double cables. The total length of these cables and overhead wires is 120 km (more than 70 miles), while the cable network of the supply company which receives energy from the mining company has a length of 130 km (80 miles). Steam turbines and gas engines are used. The total number of kw-hours produced in 1906 was 13,930,000, which was increased in 1907 to 23,900,000, of which 18,500,000 were used by the mining company itself and the balance was sold to a supply company. —*Elek. Zeit.*, May 7.

Electric Hoisting.—KAMMERER.—A long illustrated lecture held before the Berlin Electrical Society on the changes in the mechanical design of hoisting, etc., machines, due to the use of electric power, with special reference to elevators, cranes, winding machines for mines, etc.—*Elek. Zeit.*, April 23, 30; May 7, 14.

Slide-Rule.—An illustrated description of a new multiple slide-rule for steam-engine calculation, for instance, for finding quickly the power of an engine of given dimensions or reversely the size and the speed of an engine to develop a given power.—Lond. *Elec. Eng'ing*, April 30.

Traction.

Railway Converter Substations.—J. E. WOODBRIDGE.—The requirements of direct-current railway substations are so similar in the majority of cases that the author argues it would be found of value to electric railway managers and engineers to co-operate in effecting a more complete standardization of substation design and railway transmission potentials. The subject is discussed in the following order: Standard transmission voltages; standard features of the apparatus; typical station designs and details. The discussion, which is based on long, practical experience, is very concise and cannot be abstracted briefly.—*Gen. Elec. Rev.*, May.

Installations, Systems and Appliances.

Resistance of Insulators.—F. NEGRE.—An account of results of some tests on insulators. One of the poles of a Wilmshurst machine was connected with the neck of a bell insulator, and the other through a galvanometer with the attachment. The tension was measured with an electrometer. A simple bell insulator, 8 cm in diameter, and a triple bell 11 cm in diameter, were tested at 5500 volts. In another series the e.m.f. was increased to 50,000 volts. In some cases the bells were moistened with vapor or covered with lampblack. Each insulator has a "critical tension" up to which the insulating resistance is constant. This critical tension varies with the diameter and other dimensions, and with the state of moisture and cleanliness. It was found to be 11,000 volts for a simple bell, 16,000 for a triple bell, and 32,000 for an American type designed for 50,000 volts. After the critical tension is exceeded, the resistance rapidly declines, especially if the insulator is damp or dirty,

or has a small diameter. Fine water drops distributed over the surface coalesce into larger drops; these congregate on the rim and become pointed. In the dark, brush discharges are seen to start from the points of the drops. These discharges are specially marked when the potential is positive. When it is negative a faint glow takes the place of the brush discharge. —*Comptes Rendus*, April 21; abstracted in Lond. *Elec. Eng'ing*, May 7.

Regulations.—K. Wilkens.—The author criticises the police regulations on erection, operation and supervision of electric installations proposed by the Prussion government department and suggests a different set of regulations. The chief criticism made is that the government rules try to improve the quality of installation and care in maintenance by police regulations which in the opinion of the author is wrong.—*Elek. Zeit.*, May 7.

Wires, Wiring and Conduits.

Thread of Sockets.—A committee of the German Assoc. of Elec. Eng. proposes standardization of the thread of sockets, based on the Whitworth thread with a pitch of 26 threads per inch and a depth of 0.625 mm. A supplementary article of P. H. Pearls gives explanatory notes on the proposed system.—*Elek. Zeit.*, May 7.

Calculations of Coils.—An anonymous article describing a simple method of calculating the chief dimensions of a coil with tables for different kinds of wires.—*Elek. Anz.*, April 19 and 23.

Electrophysics and Magnetism.

Magnetic Alloys.—P. Asteroth.—An account of experiments on the influence of thermal and magnetic history of hysteresis and other magnetic properties of Heusler's magnetic alloys made from non-magnetic elements. Quenching of the alloys eliminates the hysteresis entirely, the "loop" being converted into a single straight line. On heating the alloys above the temperature of transformation, cooling them for three hours, and "ageing" them at a temperature of 140 deg., the hysteresis loop reappears. The coercive force becomes 18 in a casting, and the remanent magnetism 820 c.g.s. For a wrought piece the figures are 3.5 and 600 respectively. The author points out that the magnetic properties are thus largely within our control. The hysteresis has many analogies with elasticity and crystallization. It appears that quenching prevents the magnetic molecules from settling into positions in which they can obey magnetizing forces. The formation of larger aggregates encourages such mobility, but also increases the viscosity which resists the orientation. The magnetic orientation may also depend upon the rotation of electrons attached to the atoms. If this is facilitated by larger crystalline aggregations, the influence of quenching is quite clear. The elimination of hysteresis is of great theoretical interest.—*Verh. German Phys. Soc.* No. 2; abstracted in Lond. *Elec. Eng'ing*, May 7.

Radioactivity.—A paper by S. Russ discusses the distribution in electric fields of the active deposits of radium, thorium and actinium. R. D. Kleeman discusses the different kinds of gamma rays of radium and the secondary gamma rays which they produce, while W. H. Bragg and J. P. V. Matzen report on an experimental investigation of the nature of the gamma rays. The result of the latter investigation appears to be that the gamma rays are material in nature.—*Phil. Mag.*, May.

Electrochemistry and Batteries.

Copper Refinery.—F. D. Easterbrooks.—A profusely illustrated description with detailed drawings of the new electrolytic tank house of the addition of the Raritan Copper Works. There are 1188 cells, and the Walker system of tank arrangement is employed. The current density is 20 amp per square foot, the minimum current 7500 amp. The new copper furnaces and apparatus for casting wire bars are also described. There is also an editorial discussing the relative advantages of the multiple system and of the series system of copper refining.—*Electrochem. and Met. Ind.*, June.

Units, Measurements and Instruments.

Meter and Relay Connections.—H. W. Brown.—The author presents the chief principles to be observed in making connections to meters and relays, with application of these principles to questionable cases which may arise. The summary of his discussion is as follows: Alternating-current lines having series instruments may be considered positive if there is a return line that is considered negative. The direction of current is then the same as the direction of energy transmission. The direction of external current from the secondary of a shunt or series transformer is the same as if the secondary circuit were connected directly to the corresponding primary terminal. For normal action of any standard type of meter, corresponding e.m.f. and current circuits should have currents in the same direction. On standard types of meters having both series and shunt circuits, series circuits are brought out at the bottom and shunt circuits at the top, except on recording meters which have both shunt and series connections at the bottom. In the polyphase watt-hour meter, shunt circuits are above the corresponding series circuits. In power-factor meters, shunt circuits should be connected across the phase whose current passes through the series circuit on the left side as viewed from the rear.—*Elec. Jour.*, May.

Resistance Cut-Out for Electrostatic Voltmeters.—Electrostatic voltmeters are largely in use as earth detectors on high-tension circuits. According to the (Brit.) Home Office Regulations, on every completely insulated system in a coal mine an earth detector should be kept connected up continuously in circuit, so as to indicate the leakage current. As is well known, this regulation cannot be carried out, as no method is known whereby the leakage current of, for example, a 2200-volt, three-

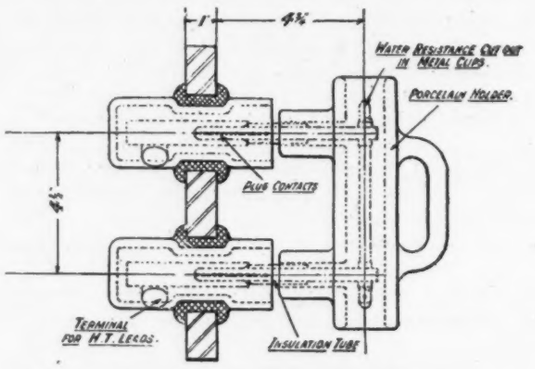


FIG. 5.—RESISTANCE CUT-OUT.

phase circuit can be continuously indicated. On such circuits, therefore, an attempt is made to comply with the spirit of the regulation by installing three electrostatic voltmeters connected between phases and ground. A British firm has brought out an instrument containing three electrostatic voltmeters in one case for this purpose. The following method of protection is provided against injury due to internal sparking: The apparatus consists of a small glass tube filled with water of a certain conductivity corresponding to the voltage of the supply. A small valve is provided in the glass tube near the bottom, consisting of a hole covered with a piece of rubber tubing. This water-tube resistor is placed in series with the electrostatic voltmeter. The current is led in at the bottom of the glass tube and taken out at the top by means of platinum wires fused into the sides of the tube. The whole is enclosed in a removable porcelain handle. The method of mounting is shown in Fig. 5. The resistance of the water tube is so adjusted that if sparking occurs, for any reason, within the voltmeter the current is limited to such an extent that only a small amount of energy is expended in the water tube. If the current continues the water is heated and boiled, and a slight jet of steam issues from the valve above referred to, interrupting the circuit. The device has been subjected to very severe tests, such as placing it directly across the terminals of a 3000-volt alternator, when the circuit was interrupted so quietly as to be scarcely perceptible.—Lond. *Elec.*, May 8.

Telegraphy, Telephony and Signals.

Telegraph Cables.—E. F. PATRITSCH.—The Austrian telegraph department has lately used for its larger installations a new type of cable in which the insulated conductors were covered with a layer of tin-foil in order to diminish and dampen the mutual induction of the conductors in the cable. While for telephone cables this arrangement has been effective in producing a certain amount of damping, it has been denied that it would be effective for telegraph cables. The author has made an extended investigation of this problem with the aid of an oscillograph. The arrangement of the experiments is described. The paper is to be concluded.—*Elek. und Masch.*, May 10.

Slightly-Damped Oscillations.—B. GLATZEL.—A description of a new method of obtaining slightly damped electric oscillations. The idea is to excite in the primary circuit an oscillation which does not run off into a damped oscillation but stops after the first quarter-period. The secondary circuit, closely coupled with the primary, then receives a single strong impulse, which produces oscillations of the proper period of the secondary circuit. If the secondary contains no spark-gap, the damping may be very slight, so that there is a way of producing very feebly damped oscillations. The coupling may be close enough to utilize the whole force of the impulse. There will be no recoil into the primary, since the latter is open. The primary impulse may be obtained by an adaptation of the Cooper Hewitt mercury arc. This has the peculiarity that as soon as the current falls below a certain value, there is not sufficient heat to evaporate the mercury, and the current is broken. This is secured by designing the apparatus in such a manner that the greatest possible amount of energy is absorbed during the first impulse. The oscillations cannot be more rapid than about 50 per second, as otherwise the current remains uninterrupted.—*Verh. German Phys. Soc.* No. 3, abstracted in Lond. *Elec. Eng'ing*, May 7.

Electrically Driven Wood-Working Plant.

The new plant of the Virginia Table Works, at Marion, Va., affords many opportunities for a study of modern wood-working plant design. This factory is completely equipped with electrically-driven wood-working machines and illustrates thoroughly the advantages of the electric drive for this class of machinery.

In deciding upon the adoption of the electric drive for this plant many factors were taken into consideration. The company desired to obtain a maximum output from a minimum operating space. It was found that with the electric drive more space could be utilized and the machines located to better advantage as regards lighting and the proper sequence of manufacturing operations. The elimination of all heavy line shafting with high friction losses and attendant annoyances from broken belts and obstructed light and the reduced fire risk were all taken into consideration.

The initial costs of the electric drive and of the mechanical drive were found to be approximately equal, but when the company learned that energy could be purchased from the local lighting company at 2 cents per kw-hour it found that with the adoption of the electric drive there would result a large saving in the cost of energy. This point has been borne out during the operation of the plant for several months.

It might be well in this connection to mention the fact that the president and general manager of the Virginia Table Works is also a manufacturer of heavy wagons. In the wagon plant, where the mechanical drive is used, the cost of energy, not including renewal of belts, amounts to more than $200 per month. When it is considered that the monthly cost of energy in the table works averages about $130 and that the number of machines in service in the two plants is about the same, it will be seen that the electric drive accomplished what is desired by every manufacturer, namely, the reduction of operating expenses.

The total rating of motors installed throughout the plant is about 175 hp. They are of the induction type manufactured by the General Electric Company. These motors have long been looked on with favor in wood-working plants on account of their simplicity and ruggedness. The absence of all moving electrical contacts in this type of motor and the consequent reduction of the fire hazard is also an important point in their favor.

The fact that the starting resistor is contained within the revolving member, thus eliminating the separate starting compensator, contributes to a wiring arrangement that is remarkably free from complication. A main switch with the necessary fuses is all that is required. The wiring throughout the plant is done in a neat and substantial manner.

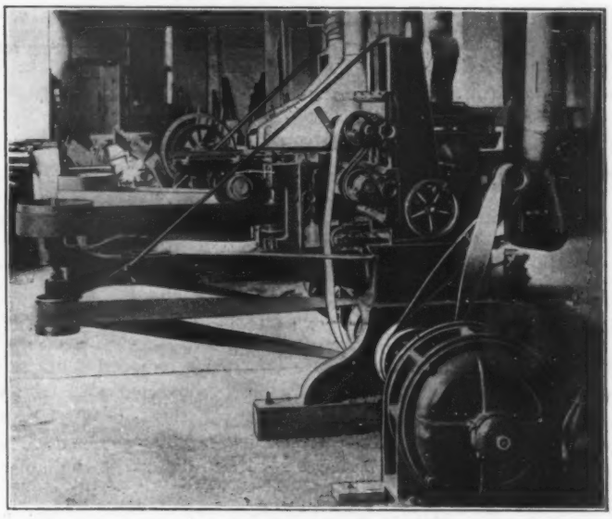


FIG. 1.—INDUCTION MOTOR DIRECT-CONNECTED TO TENONER CUT-OFF AND ROUNDING MACHINE.

The electrical energy transmission throughout the mill is at 220 volts; three-phase, 60-cycle alternating-current being supplied by the local lighting plant. In this connection it is interesting to note that although the total generating rating of of this plant is only 100 kw, or about 134 hp, energy is supplied not only to the table works, but also to several small factories in the town.

With one exception the individual drive is used throughout. In many cases the motor is direct connected by means of flexible couplings either to an extension of the machine shaft or to a countershaft contained within the machine. Where this method is impracticable, the motor is either connected to a countershaft to which the machine is belted or it directly drives the machine by means of a short belt connection.

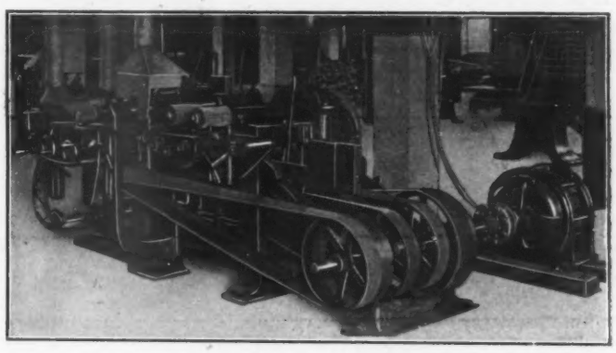


FIG. 2.—INDUCTION MOTOR DIRECT-CONNECTED TO COUNTERSHAFT OF MOLDER.

Figs. 1 and 2 are excellent examples of the direct drive. In Fig. 1, which shows a double-end tenoner, cut-off and rounding machine, driven by a 15-hp motor, the motor is connected directly to a countershaft contained within the machine. A short

belt, shown in the illustration, drives the cut-off saw attachment. In Fig. 2 a 20-hp motor is shown driving an H. B. Smith Machine Company's No. 108 9-in. molder. It will be noted that the bedplate of the machine is extended to carry the countershaft, which is direct-connected to the motor. The feed rolls and cutters are belt driven from the countershaft. This method of connection results in a compact and easily accessible unit with an abundance of head room. The absence of overhead belting contributes also to a better lighting arrangement.

A typical illustration of the belt drive without countershafts may be seen by referring to Fig. 3. A 20-hp motor is here shown driving a Merritt table-leg machine. A direct-connected motor could not be used in this case on account of the high speed of the cutter head. This same method was applied in a similar case involving the operation of a double-spindle shaper by a 4-hp motor connected to a short countershaft.

A Fay-Egan triple-drum sander is driven by a 25-hp motor. The method of connecting the motor directly to the countershaft is used throughout with the exception of one group drive.

In this case a 10-hp motor drives a countershaft from which the following machines are belt driven; two hand lathes, one spindle carver, one dovetail machine, one combination saw, two emery grinders, one post borer and a belt sander. All of these machines are small, and the arrangement is compact.

All sawdust and shavings are effectually removed from the machines by an exhaust blower direct connected to a 20-hp motor. Exhaust pipes carried directly to the floor afford an easy and effective method of disposing of the sweepings. As stated before, all refuse material is carried directly to the boiler room, where it serves as fuel.

Among the motor-driven machines not mentioned are a swing cut-off saw, glue jointer, cabinet surfacer, band saw, etc.

The operation of the plant has been satisfactory in every respect and no trouble whatever has been experienced. The factory superintendent states that he finds the electric drive to be more satisfactory in every way than the mechanical drive, giving as his reasons that the machines are located to better advantage than would be possible with long-line shafting and that the flexibility of control is greater.

The president of the concern aptly expresses his views of the electric drive in the following: "We are very much pleased

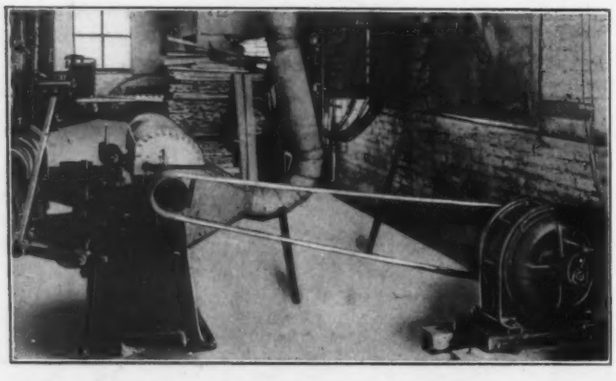


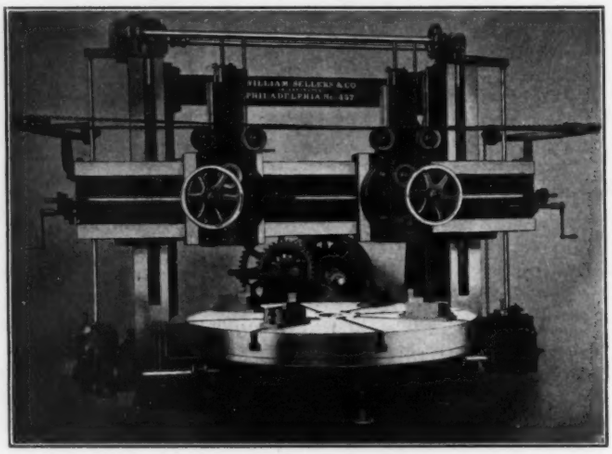
FIG. 3.—INDUCTION MOTOR BELTED TO TABLE-LEG MACHINE.

with the motor drive and everything is going along successfully. I do not hesitate to say that I would not change to any other drive I know of, even at much less cost." The Jas. D. Lalor Engineering Company, Washington, D. C., had charge of the design and general layout of the plant.

Boring and Turning Mill.

Manufacturers in this country make more extensive use of boring and turning mills than in any other country, although this useful machine tool was first developed in England. This is doubtless due to the improvements made by American machine tool builders, who have departed widely from the types manufactured by their foreign competitors. The range of use to which this machine may be put is very wide. In many shops it takes the place of a lathe, because for many classes of work it is the more economical tool, owing to the facility with which the work can be set on the face plate. In some shops it is customary to place a number of pieces of comparatively small work on the surface of the table around the edge, and thus turn almost a continuous ring. When the work permits it, both tools on the cross-head may be made to cut at the same time, one on the top of the work and the other on the side.

In order to obtain the greatest output for a tool of this



BORING AND TURNING MILL.

nature, it is necessary to provide the greatest convenience for all the movements, horizontally, vertically, engagement and disengagement of feeds, etc., so that the machine can be kept under cut as much of the time as possible. The time which is lost in preparing work reduces the output of the machine, and it is the output that brings profit. The actual investment charge for the machine will in many cases be found to be a more important item than the labor charge and hence every increase in production is a direct saving.

By using a variable speed motor installed as an integral part of the boring mill, the correct speed may be obtained in the minimum amount of time, as the controlled handle is conveniently located for the operator.

The boring mill shown in the illustration, built by Wm. Sellers & Company, Inc., of Philadelphia, is capable of taking work 84 in. in diameter. The variable speed motor, supplied by the Westinghouse Electric & Manufacturing Company, has a speed range of 2½ to 1, giving the table any speed between 1 and 23.8 r.p.m. with the exception of two small gaps. The feed may be varied from 1/32 in. to ¾ in. per revolution of the table in eight steps.

The machine is entirely self-contained and not dependent upon supplemental foundations for its rigidity, as the only portion of the machine extending below the floor line is the lever for adjusting the center step, which is accommodated by a trough 7 in. wide by 7 in. deep. The table has a flat bearing with a central spindle and adjustable step controlled by the lever mentioned above. The use of the motor permits the machine to be located where the work can be supplied to it with the least handling, thus decreasing the lost time, when the machine is not producing. The wide speed range permits work of various diameters to be turned at the maximum cutting speed.

Arc Lamps with Inclined Electrodes.

The lamp illustrated on the next page is of the inclined-electrode type with nothing below the arc to obstruct the light. Both electrodes feed by gravity simultaneously, the regulation of the arc being accomplished by the lateral movement of one electrode with reference to the other.

A serviceable reflector of refractory material surrounds the

points of the electrodes just above the arc so as to prevent the "washing" of the electrode ends, and to steady the arc from the effects of air currents as far as possible. A "blow magnet" is so situated with relation to the arc that it performs the double function of keeping the arc steadily fan-shaped at the electrode tips and also totally extinguishes the arc if for any reason it approaches dangerously near to the reflector. The reflector, therefore, is well protected from burn-out and should last indefinitely. A heavy "baffle plate" of insulating material is provided just above the reflector, thereby effectually preventing any appreciable amount of the products of the arc from depositing on the parts of the mechanism. During operation the lower surface of the bottom plate of the lamp and of the reflector becomes coated with white deposit from the arc which acts as an excellent reflector for the upward light from the arc.

ARC LAMP WITH INCLINED ELECTRODES.

These lamps are designed to burn two-in-series or singly across direct- or alternating-current circuits at from 100 to 125 volts. They can be used on any frequency between 40 and 140 cycles. The lamps may be wound for either 8, 10 or 12 amp, the latter current being considered standard. All lamps are equipped with light opal globes.

The life of these lamps is stated to be about 12 hours on indoor circuits and between 10 and 11 hours on outdoor circuits. The simple construction and the large volume of illumination obtained from these lamps appeal to the operators of mills, wharves, warehouses, erecting shops, foundries and other places where the quantity of light is as desirable as the quality. This lamp has just been placed on the market by the General Electric Company, Schenectady, N. Y.

New Electric Car.

For some months, Mr. Hiram Percy Maxim and Mr. T. W. Goodridge have been engaged in the production of a new electric car which was to have several entirely new features. This car has just made its appearance, and in several details it is a striking departure from the conventional electric carriage design. A worm-and-wheel drive is used in place of the customary gear and pinion and sprocket and chain. The mounting of the worm drive is very interesting, as will be seen from an inspection of Fig. 1. The electric motor has its shaft prolonged and the worm mounted directly upon it. The worm wheel is supported in a separate housing which is divided vertically, and attached directly to the end of the motor. The stub shafts of the differential project through this housing, as will be seen in Fig. 2. The drive is very simple, as the entire gear reduction of 10 to 1 is accomplished in one small housing which is virtually a part of the motor. All chains, chain housings, strut rods, adjustments, gears, pinions and gear housings are at once avoided, and the entire transmission made enclosed, self-contained and silent.

The great objection to the worm-and-wheel drive has been the question of loss, due to the working action being entirely a sliding one, instead of approximately a rolling one, as in the case of gears. The irreversible feature of the worm has been also a hindrance to its favorable consideration. The builders claim to have perfected a design whereby all of these faults are overcome. The worm and wheel run in oil and require no adjustment. The worm is made of steel and hardened, and the worm shaft and motor-armature shaft run on ball bearings.

Another feature of the car is the mounting of the motor and transmission. These are carried on the chassis frame. They hang just so that the differential stubs, already referred to, stand in approximate alignment with the centers of the rear

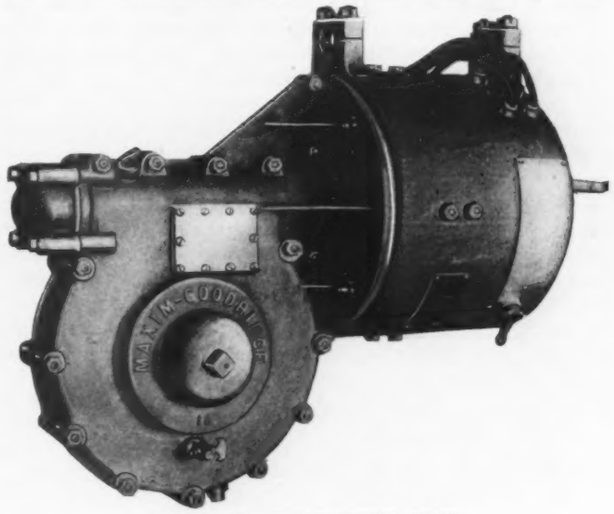


FIG. 1.—WORM-AND-WHEEL DRIVE.

wheel hubs. Two universal jointed driving shafts then connect the differential stubs with the rear wheel hubs. Up and down motion of the body is allowed for by the universal joints. For average loads these shafts are in a straight line, approximately, and only on jounces and recoils is there any motion in the joints. The rear axle is offset to allow for the clearing of the universal joints, and except for this offset, is an ordinary plain carriage axle. The rear wheels run on this axle, and driving

FIG. 2.—VIEW OF REAR OF VEHICLE.

dogs engage at the outer ends of the hubs in the same manner as in conventional floating axle design.

This carrying of the weight on the springs, instead of carrying it rigid and "dead" upon the rear axle, makes the riding of the car very much better, and also admits of the use of solid rubber tires instead of pneumatics. This demand is one that is fast developing.

The carriage is equipped with 30 Exide cells, and all of

seat and is not much greater than is the weight on the front wheels. This has an important effect in the softness of riding and materially assists the tire problem.

The control of the car is likewise original. Instead of the conventional lever projecting upward through the seat, the controller handle is mounted on the steering post just below the steering lever. There are two brakes fitted, each being a foot lever projecting upward through the floor. One brake operates on the hubs and one upon the motor shaft. The wheel base is especially long, being 84 in., which materially adds to the ease of riding. The wheel diameter is 32 in. and the tire used in both solid and pneumatic is 3½ in. The motor is of General Electric make, and the control is by means of the new style uninterrupted torque, multiple-series controller, giving five speeds ahead and three reverse. The maximum speed is 18 miles per hour. The mileage per battery charge with either solid or pneumatic tires is said to be 50 on ordinary road surfaces and much more on good city pavement. The weight of the car is 2100 lb. with the battery mentioned and correspondingly less with smaller battery and simpler body. The chassis is entirely self-contained and can be fitted with any type of body. The car is built by Maxim & Goodridge, Hartford, Conn.

New Works of Lincoln Electric Company.

Several novel features have been incorporated in the new works of the Lincoln Electric Company, East Thirty-eighth Street and Kelley Avenue, Cleveland, Ohio. The building, 120 ft. x 55 ft. ground dimensions, is of concrete block construction, well lighted and ventilated by numerous large windows on all sides. The blocks are laid up in such a manner as to provide an air space in all walls. The interior is of steel and wood treated with water paint, one of the best forms of slow-burning construction. Floors are all of 2½-in. tongue and grooved boards. Further fire protection is afforded by a composition and gravel roof and standpipes connected with the city water mains, with hose connected on each floor. Considerable attention was paid to safety features, and the architect succeeded in making the building as nearly fireproof as possible for that type of construction.

The first or basement floor contains the power and heating plants, the punching department, boring mill and storage space. The power plant consists of a Lincoln three-wire generator, giving direct current at 110 and 220 volts at one end of the machine for operating the small motors in the shops, and three-phase, 25-cycle current at the other end, which will be stepped up to 110, 220 and 440 volts for testing. For the higher voltages to be used in testing, 60-cycle current is obtained from the Cleveland Electric Illuminating Company's circuits. The equipment for these tests is located in the winding room on the third floor, and consists of a transformer with nine taps for giving from 500 to 10,000 volts in 500-volt steps. All windings are given rigorous tests before they are allowed to leave the shops.

The method of furnishing the various departments with hot water deserves mention in this connection. The water from the gas engine flows to a closed pressure tank, attached to the city water mains. This is enclosed in a sheet-metal case, with an electrically-operated fan at an opening near the bottom for cooling the water. The cooler water sinks to the bottom and is again used in the engine, while hot water is taken off through a pipe system at the top and conducted to various parts of the building. The pressure from the city mains keeps the tank filled and at the same time raises the water in the pipes to any point desired.

Another feature of the power plant is the fact that the exhaust gas is used for heating the baking room on the third floor. After leaving the engine the pipe divides, both branches going to the room mentioned. Here each one again divides, one portion extending up and the other down from the junction point. From these latter divisions 10 radiation pipes are taken off. These extend straight along the walls of the room, and those from each side enter two other larger pipes, these latter being connected by a T-section, to which the outside exhaust pipe is attached. The area of the radiation pipes is about nine times that of the pipe which carries the gas to the dividing point and each division is larger than the preceding one. By this arrangement all back-pressure is eliminated. The exhaust makes scarcely any noise because of the numerous subdivisions of the piping.

The hot gas alone is sufficient to maintain a temperature of about 175 deg. Fahr. in the room, but with the aid of an electric heater the heat is kept at 200 deg. Working under a full load the engine will probably furnish enough heat for the room without any aid from the electric heater. It is estimated that the room has the use of almost as much gas now, without additional cost, as would be required to heat it in the usual way. In other words, the gas is serving two purposes, and from an economical standpoint, this is an important feature.

In the machine shop, on the second floor, belts have been done away with entirely, all the lathes having been equipped with Lincoln motors, mounted on the machines and operated with gear transmission. All motors are of the variable-speed type, and are operated at either 110 or 220 volts, according to the speed desired. This, of course, gives a ratio of 2 to 1 and the use of field resistance for the smaller steps gives a ratio of 3 to 1, so that the total range of the machines is 6 to 1. Rapid reversal is one of the main features of these motors. Going at a fairly high speed, they may be reversed within the limit of about one revolution. Reversal is secured by a reverse current sent through the armature and the speed range in both directions is the same.

A 32-in. Schumacher & Boye lathe is served by a 5-hp motor, while a New Haven 24-in. lathe has a 3-hp motor, and an 18-in. lathe a 2-hp motor. Four 14-in. lathes are operated by 1-hp motors, and the shaper and milling machine by 2-hp motors. The absence of belts on this floor makes it possible to serve all the large machines on the east side by a traveling crane with a span of 17 ft. for the whole length of the bay, 120 ft. Provision is made for a similar crane in the east bay when it is needed, but at present it is used for lighter work which may be handled in other ways. The crane was designed by the Forest City Engineering Company, which also prepared the plans for the building.

The winding department, on the third floor, is served by an overhead trolley with track extending over the benches along the east side of the room, then turning to the west over the dipping cans and into the baking room. By the use of this trolley one man is able to handle any machine produced in the shops.

As conducted in this shop, the dipping and baking process is interesting. All armature and field windings are thoroughly dried first and then dipped into a neutral varnish, in which they are allowed to remain until bubbles cease to rise to the surface, when they are removed for baking. After being dipped into an oil-proof varnish they are given the final baking. The windings are thus thoroughly impregnated with varnish and protected from dampness and injury.

In addition to what has already been said regarding the baking room on this floor, it might be mentioned that the inside walls are made of hollow tile with an air space to aid in retaining the heat. The roof is of corrugated iron, covered by about 3 in. of sand. So thorough is the protection that little heat can be noticed at any time on the outside of the walls.

All floors are reached by an electric elevator, which was made complete in the shops of the company. It will carry 5000 lb. easily and serves all the purposes of the shop. All machines are tested to 3000 volts alternating current between the winding and ground before they are allowed to leave the shop. This insures satisfactory operation when they are put into use. The company manufactures direct-current machines from 4 hp to 120 hp and alternating-current motors from 1 hp to 200 hp, as well as magnets with a lifting capacity of one ton of scrap or pig, and long-pull solenoids for lifting bridge breaks and other purposes, with a capacity up to 500 lb. through a distance of 6 in. or 7 in.

Generating Sets for Industrial Plants.

For many years the B. F. Sturtevant Company has been manufacturing generating sets of small capacities up to 150 kw. The sets with vertical engines have been designed especially for marine lighting, and have so successfully passed the rigid government specifications that large numbers furnish the light on battleships, cruisers, excursion steamers, etc. The primary features of these sets have been capacity for continuous operation without attention and are equipped with balanced piston valves for simple engines, and piston valves and balanced slide valves for the compound type.

The success of these sets has led the B. F. Sturtevant Company to build them in larger sizes—sizes which admit of high steam economy—and they are now being placed upon the market in capacities from 150 to 500 kw, the engines being of the four-valve type and equipped with gridiron valves. To get the best possible economy, each steam valve is provided with an auxiliary cutoff valve so that the cutoff may be automatically controlled by the governor and varied according to the load independently of the other events. The main steam valves and the exhaust valves, which are also of the gridiron type, are actuated by the eccentric on the shaft.

These engines are especially adapted for industrial plants where it is desired to have power at least cost and supplied continuously, and will be appreciated by those willing to pay more for first cost, and then get the benefit of continual saving. Although economy is an important feature of this type of generating set, other advantages have not been overlooked in the design. The clearances have been reduced by making the engines of the four-valve type; vibration has been eliminated by the cross-compound type and perfect balance; and the design gives every opportunity for easy repairs. The valves are placed in cylinder castings and not in the heads, so that the cylinder heads may be removed and the piston inspected or repaired without disarranging the valve gear.

To reduce the necessity of frequently adjusting the wearing parts, the engine is equipped with an automatic system of forced lubrication. A small direct-acting pump maintains, within a system of pipes and passages, a pressure of about 15 lb. per square inch. This system supplies all the wearing surfaces within the enclosing frame of the engine, and so abundant is the lubrication that the wear is almost imperceptible, and the adjustable parts need be taken up only at very long intervals.

As further protection from dust and accident, all removable parts, except some of those connected with the valve gear, are entirely enclosed by the cast-iron frame. At the top of the frame there is a watershed partition which separates the frame from the cylinder and prevents oil within the frame entering the cylinder on the piston rod, and also makes it impossible for the condensation from the stuffing box getting into the frame and mingling with the oil. The watershed partition has a further advantage in that it protects the lower cylinder head, and as the cylinder head is maintained at a comparatively low temperature, vapors do not form on it from oil and water.

FIG. 2.—COMMUTATOR AND BRUSHES OF 10-POLE GENERATOR.

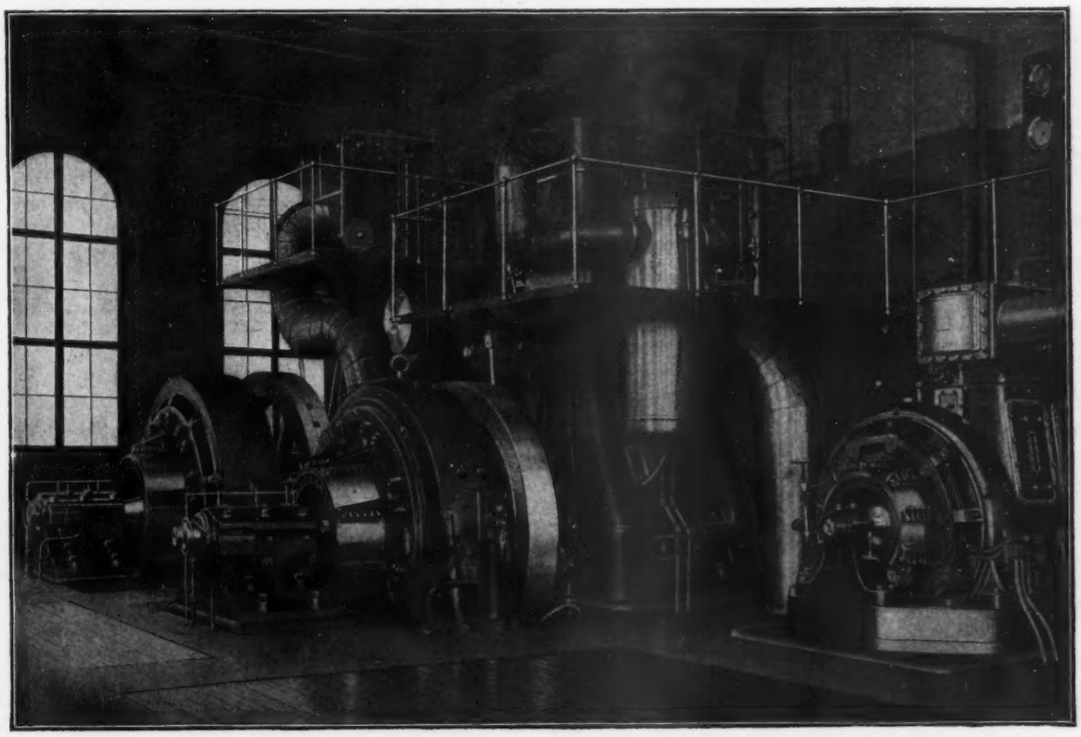


FIG. 1.—POWER HOUSE SHOWING THREE GENERATING SETS OF 100-KW, 250 KW AND 400 KW.

The generators are direct-connected to the engine shafts by flange couplings. As in the case of the engine, they are especially adapted to the power plants of factories and mills, for they are designed for a wide range of load and require little or no attention. Ample cooling surfaces and abundant ventilation contribute to freedom from heating and burn-outs. These machines are capable of carrying an overload of 33⅓ per cent

for two hours without injurious sparking, and will carry 100 per cent momentarily without destructive sparking or heating. The insulation between the windings is given a test at alternating pressure of at least 1500 volts at 60 cycles for a period of 60 seconds. Especial attention has been given to the pole pieces so that the magnetic flux is perfectly distributed and the plane of sparkless commutation constant.

The armature is of the iron-clad, drum-wound type, the core being built up of sheet steel segments, clamped between end flanges and provided with vanes which maintain a constant blast of air over the surfaces of the winding. The armature is multiple-wound and provided with cross-connecting rings, so that all brushes of the same polarity are maintained at the same potential, a feature that insures a uniform pole strength.

The commutator (Fig. 2), mounted on an extension of the armature, is built up of drawn copper segments, which are insulated with amber mica of the best quality, of a thickness that makes impossible an accidental breakdown. So perfect is the commutation of these generators that the necessity of turning off the commutator is a very remote possibility.

Carbon brushes of a size that the current density will never exceed 30 amp per square inch, are held in the latest design of sliding-socket shunt brush holders, which are clamped on a composition frame, insulated from the brush ring itself. Each brush holder can be adjusted separately and removed for cleaning and repairs, or the entire brush ring may be rotated by a hand wheel.

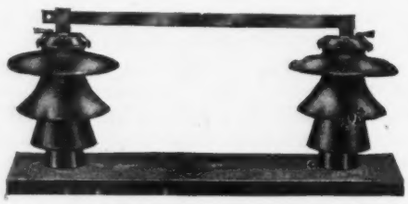
Arc Lamp Economizer.

The accompanying illustration shows a current-saving device for alternating current moving picture lamps, spot lights, search lights, photo-engraving lamps, etc., known as the "Hallberg Automatic Electric Economizer." The device has two separate windings, one primary and one secondary. The primary may be wound for any voltage from 100 to 460, and for any standard frequency. It is made in several sizes, the standard capacity for moving picture lamps being 2½ kw, with adjustments permitting 40 to 50 amp constant current at the arc. Among the claims made for the device are that it operates with a power factor of 80 per cent or more on all voltages, thus reducing the demand on the central station service to the lowest possible amount. If the arc is short circuited by over-feeding the lamp, the primary current does not increase more than 15 to 20 per cent, and the device is designed and built to stand a dead short circuit for an indefinite period without overheating. It operates without vibration, noise and heat, and the weight of the 2½-kw size is only about 100 lb. It is enclosed in a fireproof perforated brass case and may be mounted in any position on floor, ceiling or wall. When the arc is under the control of the "economizer" it cannot flame, and the carbon separation may be much less than with any other style of controller, which permits the craters of both carbon points to be focused, entirely removing the bad effects of the violet arc rays, while the intensity of the light from the craters is increased by the removal of the arc mist, which is always present when a long arc is used. The shorter arc also reduces the rate of carbon consumption and prevents breakage of the condensers in the lamp house. It saves 65 per cent on 110 volts, 83 per cent on 220 volts and over 90 per cent on 440-volt alternating-current circuits as compared with the rheostat. For moving picture lamps it is claimed to be the only device which gives perfect arc control and a steady light with large currents up to 65 amp, thus enabling the alternating-current arc to compete successfully with, and in some cases excel, the direct-current arc for the class of work referred to; and as a general rule a considerable saving on both the investment and the cost of operation can be made by using the alternating-current arc.

LAMP ECONOMIZER.

High-Potential Disconnecting Switch.

The accompanying illustration shows a high-potential switch for use with lightning arresters, for e.m.fs. of from 10,000 to 60,000 volts. It is intended for use in a case, for instance, where an arrester should prove defective or it should be desired to open the circuit for inspection. The switch is manufactured for arresters of low current but high e.m.f. The "factor of safety" is never less than 1.5 and more often is 2. The current-carrying parts are of copper, and the insulating supports of vitrified porcelain. In case of use in high-tension

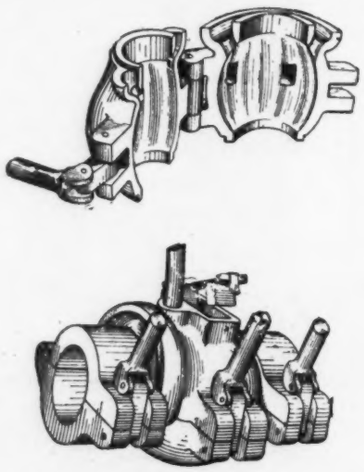


HIGH-POTENTIAL DISCONNECTING SWITCH.

circuits the switch would be connected directly into the line. It is intended to be mounted above the ground or floor, away from the reach of inexperienced persons; it can be opened only by a special rod with an insulated handle having a hook on the end fitting into a hole in the blade of the switch. This switch has been placed on the market by the Lord Electric Company, 213 West Fortieth Street, New York.

Device for Wiping Lead Joints.

A labor-saving device designed for wiping any kind of lead joint, whether for water connections or for electric-light and telephone cables, is shown herewith. The apparatus is known as the Corcoran wipe joint machine, and it is said will wipe branch joints as well as horizontal joints. A feature of the device is that by it a stronger and more perfect joint is possible than by the old method because a richer solder can be used.



DEVICE FOR WIPING LEAD JOINTS.

The solder is heated in an ordinary soldering pot and the machine is clamped around the parts to be joined and the solder poured in the trough, which has been previously heated by a blow-torch. The machine is moved back and forth a few times and then allowed to stand for a minute. When the excess solder in the trough has hardened it is removed and the machine unclamped. Clamps at either side of the device serve to center the machine directly over the joint to be made. No solder is wasted by the device, and it is made in various sizes to fit standard pipes and cables. The clamp is manufactured by the Wipe Joint Machine Company, of Cleveland, Ohio.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Industrial and trade conditions showed improvement last week, although weather and crop reports were irregular. As a whole business was much less active than at the same time last year, and sentiment, though in the right direction, is slow. Mercantile collections were more prompt and money rates low, in spite of exports of $40,000,000 in gold and Treasury withdrawals of $45,000,000. The easy financial conditions abroad are evinced by the reduction of the official rate of discount of the Bank of England to 2½ per cent, the lowest quotation since August, 1905. Bank clearings were larger than for the same week in 1907, but this was undoubtedly due to the holiday. As a whole, crop reports were uniformly less favorable than for the previous week, due mainly to excessive rainfall in large areas. These adverse reports were of assistance to grain manipulators in squeezing out the May shorts in wheat and corn. The metal trades showed some improvement and considerable purchases of pig iron, based on the present low prices, were reported. *Bradstreet's* reports business failures for the week ended May 28 as 263, compared with 284 in the previous week, 142 in the corresponding week in 1907, 127 in 1906, 154 in 1905 and 194 in 1904. Certain electrical lines show a considerable improvement in orders booked since the beginning of the month. The wire companies report a flurry in orders for immediate delivery, which, if it proves lasting, will shortly bring the output in this line back to normal. Nearly all of the wire concerns have increased their operating forces, and in some instances full time is reported. The large electric manufacturing companies are booking good export orders, but most of the domestic business is in small contracts. The report from Chicago that the Allis-Chalmers Company had placed an order for 1500 tons of pig iron and also for a year's supply of copper is stated to be correct. The electrical output of the Allis-Chalmers Company was confined formerly to the Bullock plant at Cincinnati, but arrangements have been perfected whereby the Bullock plant will confine itself to the smaller standard electrical equipment, leaving the larger and special construction to the West Allis plant, which will develop this phase of the business to the utmost. In the last two years the West Allis plant has been practically doubled in capacity, about $5,000,000 having been devoted to that purpose. The favorable showing of the company this year was due to the fact that when the financial crisis occurred it had business booked to about $15,000,000, or a 10 months' output.

A PROTEST AGAINST SHIFTLESS AMERICAN FOREIGN TRADE PRACTICES.—The following energetic criticism of the shiftless export trade methods of some American firms is received from an Australian correspondent: There is a world-wide demand for American manufactures, but your first *campaign* should begin with our brethren at home in order to teach them a few things. In the past 12 years I have had sufficient experience with American business methods to show that the average man cannot, or will not, pay sufficient attention to details and to the requests of his customers. In many cases absolutely no attention whatever is paid to specific instructions regarding packing, shipping, and customs requirements. Instructions are evidently merely glanced over hastily, and the business done in a "slap-dash," hasty manner, and in most cases complaints are merely ignored. My American mail is just in to-day, and I have to air some of my grievances before I can rest. One of the aggravations is the constant receipt of under-paid correspondence. There is scarcely a mail comes that does not bring me a lot of letters and trade circulars on which I am required to pay from 6 to 28 cents deficient postage. The thing has got so bad that I prepared a circular, which I now send with the envelope or wrapper to everyone in the United States who forwards me anything with underpaid postage. Just to let them see how it is themselves, I put a 1d. stamp on my letter. Under date of December 23, I wrote Messrs. ——— ———, with whom we have been doing business for over 10 years, asking for some particulars and quotations upon three or four different makes of "injector" or "barometric" condensers. I sent illustrations of the various types on which I wanted quotations, and indicated just what parts were required in the following language: "The portion inside of the red line on each illustration shows the part which we require. We have relief valves and all other parts. In quoting price, please designate a code word for each condenser, so that we can cable the order in case we conclude to purchase one." Now, in quoting upon one of these condensers, they include the relief valves, etc., saying "we would not care to furnish the condenser without all the parts mentioned, as we do not believe it would perform satisfactorily without these parts;" and they entirely ignored our requests for code words to enable us to order by cable. Another experience concerns an order for some books. Under date of August 6th, 1907, I sent to ———, an order for a number of books, over 35 volumes, enclosing check on the Mechanics' National Bank to cover the cost of the books, and other charges. I was most explicit in the shipping directions, instructing specifically how the case was to be marked, and that it be forwarded through Messrs. Alfred H. Post & Co., Maritime Buildings, New York (forwarding agents who handle considerable business for Australian ports), freight prepaid and insured. I also instructed that particular care was to be taken in making out the invoice, and that no advertising matter or anything not specified on the invoice, was to be enclosed with the books. (All advertising matter imported into Australia is subject to a duty of 4 cents per lb.). After considerable delay I received the invoice, and after a much longer and unexplained delay, I received the shipping documents. The invoice was dated September 12, 1907, but shipment was not made until January 29, 1908. In the bill of lading the shipment of books is described as "One case advertising matter," the box was marked entirely incorrectly, insured and with freight to collect at this end. Can you conceive how specific shipping instructions could be so absolutely ignored? They also overcharged me on many of the books, and paid no attention whatever to my letter calling attention to this. As referred to above, bad packing is one of the common offences. Expensive machinery is merely crated, and I had a shipment of furniture which was crated in the most flimsy manner, merely as though it were to be shipped in car load lots from Grand Rapids to Chicago, and with absolute disregard to the requirements for oversea shipments. Orders that goods were to be packed in zinc-lined cases were absolutely ignored, with the result that I had a shipment which was practically ruined. As we have to "pay, pay, pay," why cannot shippers follow instructions? I had an experience in a case in which an American manufacturer of iron unloaded a lot of scrap on Australians through ———, of New York. Our complaints were merely laughed at. I do not think you could sell a ton of American iron in this vicinity at any price. You have too much "system" and too little intelligence. I get these "system" letters one after another, stacks of them, while no attention is paid to my requests for specific information. I opened up a correspondence with a firm a year or two ago, and every mail brings me one of their routine system letters. There was a question about terms of payment and some other matters. I wrote asking if the terms given in their circular were the best they had to offer, and that if so, there was no use to continue the correspondence. I never received any answer to this inquiry, but their "system" letters come by every mail. In the 12 years I have been out here I have tried in every way to increase American trade, and you know very well that I control a considerable amount of business, but I have got so disgusted that I am prepared to drop it. Unless you can succeed in working a reformation in methods over there, it is useless to exert yourself in any campaign elsewhere. Much of the American style of "stock" business correspondence and advertising does not please foreigners, the English especially. They don't appreciate American "humor." The style of many letters excites only disgust. The Englishman is a very solemn individual; he even "takes his pleasures sadly," and anything in the way of levity in business correspondence, he regards in very bad taste.

WIRE TRADE SHOWS MUCH IMPROVEMENT.—During the last week the wire trade situation has shown considerable improvement and all the large companies report increased orders over the preceding week, with a marked betterment over conditions at the beginning of the year. From a basis of 30 per cent of the normal output, on which the greater number of plants were operating last fall, the ratio has increased to at least 50 per cent. During the first three months of the current year the returns showed improvement over each preceding month, but in April the demand slackened. May returns are showing well in comparison. The Habirshaw Wire Company, which recently was operating five days a week on three-quarters time, is now running on full time again. A number of large orders have been received from the West and call for immediate delivery. An officer of one of the largest wire companies said: "The wire situation, at least as compared with many electrical lines, has shown an encouraging improvement, especially of late, but the question is, will it last? While all of us have confidence in the immediate future, yet we do not feel over optimistic about the present. We believe, however, that when the nominations are settled the revival will come with a rush. Those who have been holding back will be compelled by low stocks to come into the market. With returning confidence, first one will let go, which will influence the next one, and so on, and I venture to tempt fate by prophesying that the fall of 1908 and the spring of 1909 will prove a record year for the wire manufacturers. I am led to this belief by my observations of the low state of stocks at present. The manager of one of the railroads which ordinarily uses copper wire in its outside wiring told me that this wire in certain cases was in such bad condition that the metal showed. In one instance, where repairs were absolutely imperative, the copper wire had been replaced by iron wire, all of which will have to be torn out in time. This is a fair criterion of general conditions, and this one item alone of outside wiring will mean thousands of dollars when the demand starts again." The base price for copper wire is maintained at 14¾ cents a pound, at which level it has been holding for several months.

THE KERR TURBINE COMPANY, of Wellsville, N. Y., is busy in spite of dull times executing orders as follows: Two 60-hp Kerr steam turbines coupled to No. 8 Sturtevant gas blowers for the Economical Gas Apparatus Construction Company, at Aberdeen, Scotland; 10 single stage steam turbines with disk fans for forced draft work for the Lathrop Engineering Company, New York; one 10-kw turbine generator set, direct-current, with brake testing outfit for the Agricultural & Mechanical College of Mississippi; one 4-hp single stage turbine for driving blower for the Buffalo Forge Company, for service in Mexico; one 15-kw direct-current Kerr-Sterling generator set for C. Deuterman & Sons, White Plains, N. Y.; one 150-kw Kerr-Westinghouse direct-current unit for Janeway & Carpender, New Brunswick, N. J.; one 100 k.v.a. Kerr-Burke turbine alternator for the Warren Manufacturing Company, Milford, N. J.; one 85-hp Kerr steam turbine for the Sirocco Engineering Company, New York, to drive blowers for forced draft at the New York Edison Waterside station; four 200-hp Kerr steam turbines to drive centrifugal pumps for the Wheeler Condenser & Engineering Company, New York City; one 1200-gal. Kerr-Worthington pump unit, head 470 ft., for the Mississippi River Commission, Vicksburg, Miss.; a 1-kw headlight turbine generator unit for Chas. M. Lewis & Company, of Evansville, Ind.; one 60-hp turbine to drive centrifugal pump for the Dayton Hydraulic Machinery Company, of Dayton, Ohio. Reports from the engineering salesmen in the larger commercial centers as well as the inquiries coming direct to the home office indicate a rapid and real improvement in business conditions.

TRADE WITH GERMANY.—For the 10 months ended April, 1908, according to the report of the Bureau of Statistics of the Department of Commerce and Labor, the total of imports from Germany to the United States was $121,978,179 as compared with $134,475,801 for the similiar period in 1907 and exports from the United States to Germany totaled $250,724,722 as compared with $225,847,289 for the same time in 1907. The imports from Germany to the United States included copper bars, ingots, etc., for the 10 months under consideration to the amount of 3,537,359 lb., valued at $599,361, against 5,241,344 lb., valued at $915,116, for the same period in 1907. In 1908 crude India rubber, duty free, to the amount of 2,114,262 lb., valued at $1,561,863, was imported into the United States, as compared with 3,799,499 lb., valued at $2,781,314 during the same time in the previous year. Among the exports only 35 tons of copper ore, valued at $9,000, was shipped from the United States to Germany in the 10 months under consideration in 1908, as compared with 182 tons, valued at $48,212, for the same time in the previous year. Exports of copper ingots, bars, etc., amounted to 112,214,027 lb., valued at $16,827,888, against 71,991,834 lb., valed at $15,189,629, for the same time in 1907. Electrical appliances valued at $183,135 were exported to Germany as compared with like exports in the like period of 1907 valued at $296,503. Exports of electrical machinery totaled $86,531, against $77,144 for 1907.

TORONTO ELECTRIC COMPANY'S CONTRACT WITH THE ELECTRICAL DEVELOPMENT COMPANY—It is reported in Toronto that the price which Mr. William McKenzie, of the Electrical Development Company, asks for the release of the contract which the Toronto Electric Company has with the Electrical Development Company is $1,200,000. The Toronto Electric Company was incorporated in 1886 to supply light and power to the city of Toronto, and its franchise expires in 1919. Its contract with the Electrical Development Company provides for the distribution of Niagara electrical current in Toronto. For some time the city has been conducting negotiations with the end in view of buying the plant of the Toronto Electric Company, but the negotiations have been held up by the contract which that company has with the Electrical Development Company. The contract has 17 years to run, but it is reported that Mr. McKenzie might be induced to let the Toronto Electric Company people out for $1,000,000 cash. The city cannot take power from the Electrical Development Company, and under the contract the Toronto Electric Light Company cannot take power from any concern except the McKenzie company. Officers of the Toronto Electric Company will not confirm the report that Mr. McKenzie demanded $1,000,000 of the lighting company to allow that company to cancel its contract with the Electrical Development Company.

THE FIRE LOSS.—The National Fire Protection Association, representing all of the national institutes, societies and underwriting organizations in the United States which have thus far evidenced their interest in the protection of life and property against loss by fire through joining its efforts for the general good, had its attention called at the recent twelfth annual meeting to the diasters by fire which have occurred during the past year, involving a great sacrifice of life and an enormous fire waste, as illustrated by Collingwood School, Boyerstown Theatre, and Chelsea and Atlanta conflagrations. These, following the previous experiences at Baltimore and San Francisco, again serve to emphasize the apparent disregard on the part of the general public, resulting in the loss of hundreds of lives annually and a fire waste of almost a million dollars for every business day. It is believed that the time has properly arrived when adequate laws, federal, state and municipal, should be enacted and enforced in such a manner as will unquestionably check the enormous inroads upon the material resources of our country. The association has therefore placed itself on record as favoring new restrictive legislation or the enforcement of any existing laws that can check this awful and disgraceful waste.

WATTMETERS IN DEMAND.—An American Consul in Latin America reports that the company which is furnishing the electric light in the city where he is situated is engaged in a complete reconstruction of its plant. When the work of reconstruction is completed, current or watt meters will be installed for the use of consumers. The company has not as yet made its purchase of meters, and there is an opportunity for an American firm which manufactures such a line of goods to take prompt action in the matter. There will also be an opportunity for the sale of motors for future power installations. Further particulars can be obtained from the Bureau of Manufactures, Washington, D. C.

MICHIGAN COPPER PRODUCTION.—James L. Nankervis, Commissioner of Mineral Statistics of Michigan, gives the total copper output of that state last year as 220,217,892 lb., a decrease of 4,189,967 lb. as compared with 1906. Calumet and Hecla leads the list of mines with an output of 88,000,000 lb.; Quincy is second with 19,796,058. The other large producers in the order named are: Baltic, 16,704,868; Champion, 16,489,436; Osceola, 14,134,753; Tamarack, 11,078,604, and Mohawk, 10,107,266. In 1905 the total output for the state was 217,763,382 and in 1904 208,329,248 lb.

STATUS OF THE COPPER MARKET.—Dulness characterized the copper market during the last week, with a firmer tendency Friday. The most prominent feature of the market in refined copper was the resale of millions of pounds of Japanese copper in Europe, and the repurchase of American copper sold on Oriental account in this market. In Europe dealers have been purchasing Japanese copper at 20s to 30s below the standard market, which is equivalent to obtaining it at from 12 to 12¼ cents. This was because of the financial pressure brought to bear upon the holders of Japanese metal. Domestic consumers showed little interest in the market and continue their policy of buying supplies only for immediate needs. None of the large electrical companies has entered the market to any extent, with the exception of the Allis-Chalmers Company, which has bought castings and finished copper to last until next January. Unless there is a resumption of speculative buying it is thought that in June there will be a flood of metal on the market which will send prices down to the lowest levels of the year. Monday's prices on the Metal Exchange were as follws:

Lake	12¾ @ 12⅞
Electrolytic	12½ @ 12¾
Castings	12⅜ @ 12½

The London market was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	57 12 6	57 15 0
Standard copper, futures	58 5 0	58 7 6
Market	Steady.	Quiet.
Sales of spot		200 tons
Sales of futures		300 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 10 0
London, futures	64 10 0	56 17 0
London, best selected	67 10 0	60 5 0

The report of the Amalgamated Copper Company for the fiscal year ended April 30 last showed a decrease in net income of $7,473,843, but owing to the fact that dividends were reduced to a 2 per cent basis, the company was able to clear the small surplus of $525,041. The directors of the North Butte Mining Company have resumed dividend payments on the stock by the declaration of a $1 dividend, payable June 25.

FOREST PRESERVATION.—An important step in the general movement to bring many of the rich stands of timber in the South under a scientific plan of forest management is the offer made by the school of forestry of the University of Georgia at Athens, Ga., to furnish timber owners experts who will examine and report upon any of the forests in the State. The object of the offer is to collect information in regard to the forest resources of the State, to spread a knowledge of forestry and to improve forest conditions. The forest school will furnish the experts free and the only expense which will be borne by the forest owner will be for the traveling and subsistence expenses of the expert while making the examination. In cases where several owners of the same locality apply the expenses will be prorated. When applications for examinations are made, the owners have been asked to give their names and post office addresses, location of tract, area of tract, character of forest as shown by the kinds of trees growing on the land, the conditions of the forest, whether mature, original or second growth, whether the land has been burned or cut over, and the wishes of the owner regarding the use of the land.

CROCKER-WHEELER EQUIPMENTS.—The Warrenton Woolen Company, of Torrington, Conn., is equipping a new mill with electric motors furnished by the Crocker-Wheeler Electric Company, of Ampere, N. J., through its Boston office. The installation will include individually driven looms, each operated by a 1-hp, 550-volt induction motor, and other machinery to be group driven. Twenty-two motors will be installed, varying from 1 to 75 hp in size. The Boston office of the same company is supplying apparatus for an enlargement of the plant of the National India Rubber Company, of Bristol, R. I. One 40-kw and two 200-kw, three-phase, 550-volt, 60-cycle generators, 210 kw in transformers, arc lighting equipment and six 75-hp motors will be installed. Another recent contract taken by this office is an equipment for the Windham Mfg. Co., of Willimantic, Conn., F. P. Sheldon, of Providence, consulting engineer. The apparatus includes two 250-kw, three-phase, 600-volt generators, four 35-hp, three 50-hp and two 75-hp induction motors and transformers. A combination of electric and mechanical drive is being applied.

BRITISH PATENT LAW.—A special dispatch from London of May 26, says: "Representations have been made to the Foreign Office by Ambassador Reid with the view of a modification of the new patent law of Great Britain. This law was introduced by David Lloyd-George, then President of the Board of Trade, and comes into effect July 28. It provides for the revocation of all patents unless the actual process is carried on in the United Kingdom. Owners of American patents contend that this act will work a hardship on them, and as the United States respects all patents, whether American or foreign owned, they argue that Americans should receive equal treatment in Great Britain."

VANCOUVER POWER DAM.—We are advised by Mr. W. H. Hazlitt, purchasing agent of the British Columbia Electric Railway Company, Limited, of Vancouver, B. C., that the Vancouver Power Company of that city, intends to build a permenant concrete dam at the outlet of Lake Coquitlan, about eight miles from New Westminster Junction, B. C. Engineers and contractors are invited to send representatives to the site so that plans, specifications and tenders may be submitted. The dam will be approximately 200 ft. wide at the crest, 300 ft. over abutments and about 60 ft. high.

FACTORY AND WATER POWER.—It is announced that the large property at Northside, Waterford, directly opposite to the city of Cohoes, N. Y., known as the Massasoit Mills, and belonging to the estate of Edward G. Munson, deceased, including a large knitting mill, also a new wadding plant in perfect working order, together with valuable water rights, estimated at 600 hp, will be sold at public auction under foreclosure proceedings, on the premises on June 20, 1908, at 11 o'clock a. m. Mr. Jacob L. Ten Eyck is the referee.

Financial Intelligence.

THE WEEK IN WALL STREET.—The unstability of the stock market during the last week puzzled even the veteran professional element and made it impossible to predict in what direction the next movement would take its course. After a decline lasting more than eight days and averaging as much as 10 points in some of the leading issues, the market at the end of the week took up again the upward movement, under a broader buying demand than has been heretofore experienced. At the beginning of the week sentiment was considerably upset by the filing of the government suit against the New York, New Haven & Hartford Railroad Company and the fear was acute that this movement on the part of the Federal authorities was the beginning of further governmental attacks upon corporations with the evil effects that would ensue upon securities both here and abroad. A fairly reassuring statement from Washington did much to clear the situation. Those who do not take a particularly optimistic view of conditions at the present time maintain that the distribution of stocks on the recent advance was more extensive than realized by the Street as a whole, and in their opinion the large financial interests will not be disposed between now and the approaching national convention to give aggressive support to the market, though it is pointed out by others that the bond flotations in the interests of which the advance was said to have been brought about have not all made their appearance. The improving tendency of values toward the end of the week was restrained by a severe break in the securities of the Gould roads on the approach of the time for the payment of the coupons on the bonds of the Wabash-Pittsburg Terminal Company falling due June 1, and on which as early as the middle of the week it was generally believed that default would be made. A further disturbing influence in the Gould securities was the publication of the statement of earnings of the Missouri Pacific system, showing that in nine months ended March 31 the surplus available for dividends was slightly less than 3 per cent, making it practically certain that in the full year the equivalent of a 5 per cent dividend could not be earned. Among other incidents was a decline in American Smelting and Amalgamated Copper, traceable to reports about the position of some interests identified with the former property. Brooklyn Rapid Transit sold off on the announcement of its refusal to come to terms with the City of New York in regard to the use and operation of the new bridge loop, while the Interborough-Metropolitan developed some strength on the statement that an extension of its interests in Brooklyn was contemplated. In the money market the most important de-

velopment of the week was the reduction in the discount rate of the Bank of England. The rate was cut on Thursday from a 3 per cent quotation to 2½ per cent, making the sixth reduction of the present year. The Bank's rate has not been as low as 2½ per cent since September, 1905. The gold movement abroad has not been the source of concern among bankers as banks are in possession of a surplus exceeded only once or twice in their history. The market on Monday displayed an extraordinary burst of activity and gains from 2 to 6 points in a score of issues were recorded. The passage of the Aldrich-Vreeland currency bill, the adjournment of Congress and the report that the Union Pacific financing would be carried out before the close of the day were the explanations given for the upward movement, but these are inadequate to explain the strength of the movement, which was plainly due to manipulation by the same interests which engineered the previous rise. Closing prices of leading electrical securities on Monday were:

NEW YORK.

	May 25.	June 1.	Shares Sold.		May 25.	June 1.	Shares Sold.
All.-Ch.	9¼*	9⅛	1,000	Int-Met., com..	12¾	12¼	17,250
All.-Ch., pfd....	24	24⅜	1,700	Int.-Met., pfd..	32⅜	33	25,550
Amal. Cop.....	65¼	67¼	146,095	Mackay Cos....	66	65⅝*	900
Am. D. T.....	39*	39*	———	Mackay Cos., pfd	65	65*	700
Am. Loc.....	49¼	50⅝	5,720	Met. St. Ry....	27	27*	100
Am. Loc., pfd..	103*	103*	———	N. Y. & N. J. Tel.	105*	110	———
Am. Tel. & C'bl.	60*	65	5,000	Steel, com.....	37½	38⅞	354,170
Am. T. & T....	117½	117¾	650	Steel, pfd.....	101⅜	102¾	24,985
B. R. T.....	51	49¼	75,120	W. U. T.....	57¼	56¾*	1,450
Gen. Elec.....	133½	138	969	West'h, com....	51	51¼	5,940
Hud. R. Tel....	—	—	———	West'h, pfd	67	70½*	900

PHILADELPHIA.

	May 25.	June 1.	Shares Sold.		May 25.	June 1.	Shares Sold.
Am. Rys.....	44¼	44¼	———	Phila. Elec.....	8¼	8½	———
Elec. Co. of Am.	10	10	———	Phila. R. T.....	15¼	14¾	———
Elec. Stor. B'ty.	30	30½	———	Phila. Traction.	—	90	———
E. S. B'ty, pfd..	—	—	———				

CHICAGO.

	May 25.	June 1.	Shares Sold.		May 25.	June 1.	Shares Sold.
Chicago City Ry.	160	160	———	Met. Elev., Com.	18	18	———
Com. Edison....	94¼	94⅛	———	Met. Elev., pfd.	54	55	———
Chicago Subway.	21¾	20⅜	———	National Carbon.	63	64	———
Chicago Tel. Co.	122	123½	———	Nat. Carbon, pfd.	110	110	———

BOSTON.

	May 25.	June 1.	Shares Sold.		May 25.	June 1	Shares Sold.
Am. Tel. & Tel.	117½	117⅞	———	Mass. E. R., pfd.	—	44	———
Comb'ind Tel...	—	—	———	Mex. Tel., pfd..	—	5⅝	———
Edison El. Ill...	214	213	———	New Eng. Tel'p.	112	111½	———
Gen. Elec.....	134½	138	———	W'st Tel. & Tel.	6¼	6	———
Mass. Elec. Ry..	—	9	———	W. T. & T., pfd.	—	67	———

*Last price quoted.
Shares sold are for week May 25 to June 1.

TELEPHONE BONDS AND THE MASSACHUSETTS SAVINGS BANKS.—A bill has passed the Senate and House of the Massachusetts Legislature and will shortly be presented to the Governor for signature making legal for investment of savings banks in that State the American Telephone & Telegraph Company's collateral trust 4 per cent bonds of 1929. By the terms of the amendment the company is obliged to have a majority of its directors from Massachusetts, and the savings banks cannot invest more than 2 per cent of their deposits in telephone bonds. The text of the bill states that savings banks may invest in bonds of a telephone company of which a majority of the directors are residents of the State, provided that during each of the five fiscal years of such telephone company next preceding the date of such investment: 1. The gross income of such telephone company shall have been not less than $10,000,000 per year. 2. Such telephone company shall have paid the matured principal and interest of all its indebtedness. 3. Such telephone company shall have paid in dividends in cash an amount equal to not less than 6 per cent per annum on all its outstanding issues of capital stock. 4. The dividends paid on the capital stock shall not have been less than the total amount necessary to pay the interest upon its entire outstanding indebtedness. It is further provided that such bonds shall be secured either by a first mortgage upon at least 75 per cent of the property of such telephone company, or by the deposit with a trust company incorporated under the laws of Massachusetts of bonds and shares of stock of other telephone corporations under an indenture of trust which limits the amount of bonds so secured to 75 per cent of the value of the securities deposited as stated and determined in the indenture; and provided that during each of the five years next preceding such investment the annual interest and dividends paid in cash on the securities deposited have amounted to not less than 50 per cent in excess of the annual interest on the bonds outstanding and secured by the deposit.

REORGANIZATION COMMITTEE GRANTS THREE WEEKS EXTENSION TO WESTINGHOUSE STOCKHOLDERS.—The report of the Merchandise Creditors' Committee and the Stockholders' Committee on Tuesday, June 2, to the Reorganization Committee made such a good showing that an extension of three weeks was granted to enable the first two committees mentioned to complete their part of the reorganization plan. The Merchandise Creditors have taken $4,000,000 of the "assenting stock" in exchange for their claims and on Friday last 1700 stockholders out of a total of 3800 had been heard from and had subscribed for stock to the amount of $1,600,000. It was hoped that on the last day for subscriptions from stockholders the amount would total $1,800,000. Only about $1,500,000 is required for the successful conclusion of the plan and it is pointed out that should the stockholders yet to be heard from fail to subscribe this amount, it would pay the bondholders to make up the deficiency in order to prevent the company from being sold for the benefit of the creditors, as the rise in the price of the bonds following such action on the part of the bondholders would amount to more than the sum subscribed by them.

MACKAY COMPANY STOCK.—The Boston *Financial News* in commenting on Mackay securities says that sales of the stocks of the Mackay Companies are few and far between in the local market, but up in Montreal they take more interest in this company and the quotations are much more frequent. At the present time the shares are strong there and there is a decidedly bullish sentiment prevailing. A prominent Montreal interest, in discussing the present situation, said: "The Mackay issues hold strong, but have not yet enjoyed so full a recovery as some other issues. The four months' statement of the American Telephone Co. shows a large increase in earnings and it must be remembered that this is one of the companies in which the Mackay Companies have very large holdings. It is on increasing earnings such as these that the expectation is based that the dividend on Mackay common stock will be increased, so soon as normal commercial conditions indicate a probability of earnings continuing to permit the payment of a 5 per cent rate. The common stock of the company, therefore, carries speculative possibilities not shared with the preferred issue."

BELL TELEPHONE OF PENNA.—The report of the Bell Telephone Company of Pennsylvania and controlled companies, shows an April gross of $981,859, an increase of $88,140 over April, 1907, expenses of $620,435, an increase of $23,622 over the same month in the previous year and a net for April of $361,424, an increase of $64,518 over the net of April, 1907. Deducting charges of $84,905 left an April surplus of $276,519, an increase of $43,064. The gross for the four months was $3,870,840, an increase of $372,805 over the same period in 1907; expenses, $2,485,444, an increase of $81,252, and the net for the four months $1,385,396, an increase of $291,553. Deducting charges of $331,021, left a four months' surplus of $1,054,375, as compared with the surplus for the corresponding four months in 1907 of $838,152, an increase of $216,223.

DIVIDENDS.—The General Electric Company has declared the regular quarterly dividend of $2 a share on the capital stock, payable July 15. The Harris Trust and Savings Bank, Chicago, has been appointed local transfer agent for the Kansas City Railway & Light stock. The annual meeting of the Electrical Properties Company will take place on June 10. Books close May 26 and reopen June 11. A cash dividend of 1 per cent has been declared by the Wilkesbarre Gas & Electric Company, payable July 1. The semi-annual dividend of 1½ per cent, payable June 15, has been declared by the directors of the Northern Ohio Traction & Light Company.

KANSAS CITY RAILWAY & LIGHT CO.—The report of the Kansas City Railway & Light Company for April gives gross earnings of $492,472, an increase of $19,806 over April, 1907; expenses, $267,657, an increase of $21,937 over the same month in the preceding year and an April net of $224,815, a decrease of $2,131 from the net of April, 1907. The April surplus was $73,799, as compared with $77,120 for April, 1907, a decrease of $3,321. The 11 months surplus was $1,010,140, an increase over the similar period in 1907 of $29,425.

PRICE FOR ELECTRICITY IN BOSTON.—The Massachusetts Gas Commission has recommended that on and after July 1, 1908, the Edison Company, of Boston, reduce the price for electricity for any use to a uniform price, not to exceed 12 cents per kw hour, and that on or before October 1, 1909, the uniform price shall be further reduced as may be approved by the commission, unless the company show good cause why such further reduction should not be made.

WOONSOCKET-PAWTUCKET MERGER KILLED.—The refusal of the City Council of Woonsocket, R. I., to withdraw its opposition to the proposed $3,000,000 merger act, incorporating the Blackstone Valley Electric Light & Gas Company as a holding company for the two Woonsocket and two Pawtucket companies, practically puts an end to the efforts on the part of the backers of the plan to put the deal through. As a result of the opposition on the part of the City Council the promoters of the proposed merger say that they will not run counter to the wishes of the City Council and will make no attempt to have the matter reported from committee or passed by the General Assembly, as had been planned. The merger which would have been effected under a Maine or New Jersey charter, would have had the effect of reducing the rate of gas in Woonsocket, but as the situation stands at present the prevailing gas rate will continue. Stedman Buttrick, of Estabrook & Co., of Boston, representing the financial interests behind the plan, stated that his concern was done with the merger under the Rhode Island charter and that the action of the Woonsocket City Council had finished the matter as far as the firm he represented was concerned. Mr. Buttrick explained to the City Council why the syndicate desired the passage of the act merging the four companies into a holding company, and presented the concessions previously outlined, which would be granted in the price of gas and the improvement in lighting properties which would follow in return for the withdrawal of opposition on the part of the City Council. In explaining the proposition Mr. Buttrick said the bonds of the merger company could be sold at from 1 to 1½ per cent lower rate of interest, if guaranteed by direct mortgage, under a Rhode Island charter than would be the case if the company was compelled to go to Maine or New Jersey for a charter. In return for co-operation on the part of the City Council, he said the company would spend about $1,000,000 in Woonsocket during the next five years, and guarantee $250,000 improvements within a year. Although making no definite promises except a $1.25 rate for gas without a franchise immediately, he said the company would at once take up the franchise question with the City Council and would grant substantial reductions in rates in return for an exclusive franchise. The majority of the City Council expressed themselves as against withdrawing opposition to the merger unless the Pawtucket price of $1.10 per thousand feet, or some price approximating that figure, was guaranteed. Several of the City Councilmen spoke in favor of accepting Mr. Buttrick's promises of further concessions in price with the granting of an exclusive franchise which would guard the company from competition in Woonsocket in the matter of gas, but the majority of the members stood firm against the merger unless those behind the measure would grant the Pawtucket gas prices or prices approximating them, to the consumers in Woonsocket.

UNEARNED COPPER DIVIDENDS.—The year of 1907 was notable in respect to the large number of copper-mining companies which failed to earn the dividends chargeable against the profits of that year, according to the *Boston News Bureau*. Eight prominent instances were Anaconda, Calumet and Arizona, U. S. Smelting, Quincy, Utah Consolidated, North Butte, Mohawk, and Tamarack, which collectively paid dividends of $17,943, 580 or $7,765,621 more than net earnings. The primary cause for this condition was the unrealized expectations of copper mine managements in general that the metal market would "come back" in the latter half of the year. In the hope that copper would be saleable at somewhere near the high average of the first six months, dividends were disbursed with a free hand, but it so happened that millions of pounds of unsold copper had accumulated on Dec. 31, and, when the depreciation in stocks on hand had been charged into the year's business, the item of net profits in many instances was alarmingly small. The copper mining company which showed dividends fairly earned in the year 1907 was the exception rather than the rule. In this class, among the mines which have reported for the year, can be mentioned Osceola and Tennessee Copper, each of which show a small surplus over dividends paid. There were interests in Osceola, however, favorable to the declaration of a small dividend for the last half of the year, but when the Calumet & Hecla people, as the owners of a controlling stock interest, were approached on the subject, they replied that "if Osceola was in our shop no dividend would be paid." No disbursement, therefore, was voted. In the case of Copper Range, it is apparent from a careful study of the annual report that only three dividends, instead of four, were charged against the year's income. The dividend ordinarily payable in December was this year made payable Jan. 1, 1908, so that it stands as a charge against 1908 income. The exclusion of this $1 dividend, which would have amounted to $384,000, together with the inclusion as earnings of $549,251 received in the Burrage settlement enabled the company to show a small surplus over dividend disbursements. In the majority of cases the well-posted copper companies knew around April 1 that there was a sudden and mysterious disappearance of copper orders, although of course deliveries were at that time being made of 25-cent copper sold in the early months of the year. In the face of a continuance of this absence of new demand throughout the balance of the year, many companies distributed earnings which could not have been fairly earned on anything less than a 20-cent copper market. The unparalleled demand which made possible 26-cent copper, it was argued, could not disappear over night, and so, as above stated, the hope of its speedy return prompted what now proves to have been a too lavish distribution to stockholders.

STONE & WEBSTER PROPERTIES.—The following are given as the gross earnings for March, 1908 of the various Stone & Webster properties, and the increase or decrease of the month, as compared with March, 1907: Houghton County Electric Company, Houghton, Mich., $18,750, Inc. $301; Whatcom County Railway & Light Company, Bellingham, Wash., $28,561, Inc. $2,005; Columbus Electric Company, Columbus, Ga., $28,700, Inc. $2,251; Dallas Electric Corporation, Dallas, Tex., $87,446, Dec. $2,046; El Paso Electric Company, El Paso, Tex., $43,640, Inc. $3,102; Northern Texas Electric Company, Fort Worth, Tex., $91,650, Dec. $105; Galveston-Houston Electric Company, Galveston and Houston, Tex., $83,530, Inc. $1,246; The Houston County St. Ry. Co., Houghton, Mich., $19,773, Dec. $642; Jacksonville Electric Company, Jacksonville, Fla., $36,965, Inc. $2,759; Savannah Electric Company, Savannah, Ga., $48,160, Inc. $994; Tampa Electric Company, Tampa, Fla., $43,121, Dec. $406; Puget Sound Electric Ry., Tacoma, Wash., $127,448, Dec. $2,165; The Seattle Electric Company, Seattle, Wash., $353,462, Inc. $34,558; Pensacola Electric Company, Pensacola, Fla., $19,205, Inc. $1,920; Brockton & Plymouth Street Railway Company, Plymouth, Mass., $7,254, Inc. $424; Edison Electric Illuminating Company of Brockton, Mass., $16,962, Inc. $2,355; The Lowell Electric Light Corporation, Lowell, Mass., $26,503, Inc. $2,316; The Minneapolis General Electric Company, Minneapolis, Minn., $83,089, Inc. $9,977; The Electric Light & Power Co., of Abington and Rockland, North Abington, Mass., $4,783, Inc. $1,080; Cape Breton Electric Company, Limited, Sydney, C. B., $17,432, Inc. $2,601; Fall River Gas Works Co., Fall River, Mass., $29,449, Inc. $1,265.

ELECTRICAL SECURITIES.—Notwithstanding the recent slump in Wall Street which brought prices down from the record levels of 1908, the leading stocks still show substantial increase over the low prices for the year. Following are given the high and low prices for 1908 of representative electrical securities, with the net change recorded on May 29 over the low for the year:

	High.	Low.	May 29	Net Increase.
Allis-Chalmers, com.	9⅞	5	9	4
Allis-Chalmers, pfd.	25⅞	14	24¾	10¾
Brooklyn R. T.	54	38⅜	47¾	9⅜
Gen. Elec.	142	111	137½	26½
Int.-Met.	12⅜	6¾	12⅛	5⅜
Int.-Met., pfd.	33½	17⅞	32	14⅛
Mackay Cos.	66	52	65⅝	13⅝
Mackay Cos., pfd.	68	59⅞	65	5⅛
Westinghouse, com.	58	38	50	12
Westinghouse, pfd.	80	59½	70½	11

BUTTE ELECTRIC COMPANY BUYS OLD PARROT SMELTER.—The Butte Electric & Power Company has purchased from the Amalgamated Copper Company the smelter at the Parrot mines at Parrot, Mont., six miles north of Whitehall, and all the rights to the land and the water power controlled by the Amalgamated Company at that place. The smelter at Parrot has never been used, having been abandoned when the Amalgamated Company took over the Parrot Company in 1900. Most of the expensive machinery at that time was removed to the Washoe smelter at Anaconda. The original works at Parrot are said to have cost $1,000,000, and 160 cars of concrete were used in building the great stack of the smelter which was never used. The consideration paid for the works by the power company has not been given out, but is thought to be far below the first cost.

AN ENGLISH VIEW OF THE FINANCIAL CRISIS.—Proper curtailment in the manufacturing output and the agricultural prosperity of the country are the factors which will bring about a readjustment of the financial situation in America, and in a short while will set the country firmly on the road to its former prosperity in all lines of trade, according to Mr. Seymour Bell, the British commerial agent in the United States. In a recent report to Parliament on this subject Mr. Bell said: "The year 1907 was one of sharp contrasts in the United States. It was a year of great activity and deep depression. During the earlier months all industries were exceedingly busy and mills were working at their utmost capacity. Many unfilled orders had been carried over from the previous year and buyers were experiencing great difficulty in getting delivery of their goods. The railway lines were congested, wages were at their highest, and the high price of commodities raised the price of living to an extreme point. It was recognized by all those in a position to form an independent opinion that this tremendous industrial activity could not last; that it was merely a question of time before a reaction would set in. It became quite evident that the country was living beyond its means. Money was becoming scarce and the railways and other corporations were encountering great difficulties in obtaining the capital necessary to carry on the improvements and extensions which were in process of being carried out. Speculation in mining and real estate had been rife and personal extravagance was at its height. This all tended to place additional burdens on the money supplies which were hardly adequate to carry on the industries of the country. The panic was entirely financial. It has, it is true, brought about a widespread suspension of trade and industry throughout the country, but there has been no throwing on the market of merchandise at ruinous prices, the usual accompaniment of industrial panics. The manufacturers, on the contrary, faced the inevitable, and without delay proceeded to curtail the supply and thus reduce such chances as there might have been of glutting the market with unsalable articles. Fortunately for the country, warning of the trouble was given early, and it was possible to take steps in time to prepare for it. The cloud of uncertainty, which has been hanging over the country for so long and gradually growing more threatening, is now passing away, and it may be said that the worst of the storm has now passed. There will in all probability be mercantile disturbances for some months to come, but readjustment and recuperation are well under way, and unless labor troubles should retard the improvement or monopolies of capital interfere to keep up prices at too high a level, it is expected that before many months have passed business will be on a safer and more normal basis."

CONSOLIDATED GAS BONDS.—Pouch & Co., of 18 Wall Street, New York, in a circular inviting investment in Consolidated Gas sucurities say that controlling the entire gas and electric lighting of Manhattan Island, and interested in other nearby companies, it has an uninterrupted dividend record of 23 years, at a rate of 4 to 8 per cent. They also say: "One of the most important steps recently taken by this corporation began with the acquisition of property at Astoria, L. I., where the first unit of an enormous gas plant was built, beginning its operation in December, 1906, by making about 4,000,000 cubic feet of gas per day. The entire plant when completed will consist of 6 units and will have a capacity of 90,000,000 cubic feet per day. The completion of the additional units will enable the company to gradually transfer its operations in the manufacture of gas across the East River, which undoubtedly will so enhance its real estate holdings in New York City that they will prove, on a lease basis alone, a source of considerable annual income. In connection therewith we find that the total assessed valuation of all New York City real estate to-day as compared with 10 years ago is about 2½ times greater—suggesting future enhancement when the transfer to Astoria is completed. It has been claimed on good authority that the present 4 per cent dividend has been met entirely by the large relative profits accruing from the electric light business, which bids fair to assume enormous proportions in the near future."

GENERAL ELECTRIC CURTAILING OPERATING EXPENSES.—Preliminary reports indicate that the operating expenses of the General Electric Company will be materially reduced this year, particularly in the item of construction. For the last year $3,745,989 construction was charged to operating, but this year it is estimated that the item of construction will not be more than $1,000,000. The operating ratio of the General Electric Company runs very high. Last year it was 92.3 per cent, as compared with 88.4 per cent in 1906-7, 85.8 per cent in 1905-6 and 85.4 per cent in 1905. For the three months ended April, 1908, the company booked $10,033,173 in new orders and billed for shipment $9,208,826, equaling a rate of about 67 per cent of the business of the fiscal year ended January 31, 1908.

MANHATTAN RAILWAY COMPANY BOND ISSUE.—The matter of the application of the Manhattan Railway Company for permission to issue 4 per cent bonds to the amount of $10,818,000, under the terms and provisions of its consolidated mortgage, dated Feb. 26, 1890, and on the company's second application to issue $894,000 additional bonds of the same character and under the same conditions, was the subject of a hearing before the New York Public Service Commission of the First District last week. The two proposed bond issues will be used to take up the $10,818,000 6 per cent first mortgage bonds of the Metropolitan Elevated Railway Company, now a part of the Manhattan, which mature July 1, 1908. As the bonds to be taken up bear 6 per cent interest, and as those of the Manhattan to be issued bear interest of only 4 per cent, it is necessary to ask permission to issue the additional $894,000 bonds to provide sufficient funds with which to take care of the maturing issue. Counsel for the Manhattan company explained at the hearing that possibly it might not be necessary to use all the proceeds of the $894,000 issue to make up the amount required for taking up the Metropolitan issue. Any surplus funds under the mortgage must be used for extensions and betterments. The right to issue the $894,000 additional bonds exists in that an extension of 1.49 miles of elevated road made within the last few years has no bonds standing against it, while under the terms of the mortgage the company may issue bonds at a rate not exceeding $600,000 per mile of double-track railway and $300,000 per mile of single-track railway. It is figured that the displacement of the maturing 6 per cent bonds by new 4 per cent bonds will save the Interborough Rapid Transit Company, which leases the road and guarantees charges, in interest about $180,000 yearly. No contract for the sale of bonds has been made.

INTERBOROUGH-METROPOLITAN NOTES.—Arrangements have been concluded by the Interborough-Metropolitan Company to extend the $4,500,000 notes due May 27 by exchanging them for new notes bearing 6 per cent interest, the exchange being made dollar for dollar. All the holders except a very few agreed to the exchange and the holdings of the non-assenting are to be redeemed in cash. A year ago the Interborough-Metropolitan Company sold $8,050,000 six months 6 per cent notes, which were extended for six months more. While this amount has been reduced the collateral held for the original amount is still held as collateral.

PRESIDENT SUNNY OF THE CHICAGO TELEPHONE COMPANY.—President B. E. Sunny, of the Chicago Telephone Company, says that frankness will be the keynote of his policy in dealing with the public. He reports an increase of 100 calls daily in the last month and the total daily calls now are about 1,150,000. "Of the 23,588 telephones installed this year," he says, "16,625 were new subscribers. Half of the 5,000 telephone orders on hand are for underground conduits. The operating force was reduced from 3,900 to 3,600, but the 300 are being put back as business is improving. Expenses will be as liberal as necessary to give satisfactory service."

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY INVENTORY.—Acting Governor Draper, of Massachusetts, has signed the measure which provides that the Massachusetts Highway Commission shall cause to be made an inventory and appraisal of the property of the New England Telephone & Telegraph Company within Massachusetts, and authorizing the expenditure of $30,000 for that purpose.

UNITED RAILWAYS STOCKHOLDERS BRING SUIT.—Reports from San Francisco state that Joseph A. Sullivan, owner of stock in the United Railways Investment Company of New Jersey, has brought suit in equity to recover for the stockholders $200,000, which Patrick Calhoun, president of the United Railroads, is alleged to have paid to Abraham Ruef to influence supervisors to grant franchises to the company.

WORCESTER (MASS.) LIGHTING COMPANY.—The Worcester Gas Light Company has petitioned the Gas & Electric Light Commission for authority to issue 2000 shares of additional capital stock, the proceeds to pay for enlargement and improvement of the plant.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

ABBEVILLE, ALA.—Plans are being considered for the construction of an electric light plant, contracts for which will be placed in the near future. The cost of the plant is estimated at $12,000. P. A. McDaniel is mayor.

VALDEZ, ALASKA.—The Alaska Water, Light & Telephone Company has been granted a 25-year franchise in Valdez. The company has a hydro-electric plant at Solomon Basin, and will construct several large reservoirs during the summer to provide a supply of water for use during the low-water period during the cold weather.

HOLBROOK, ARIZ.—H. Lee Chilson, of Winslow, has been granted a franchise to construct and operate an electric railway from Holbrook to Fort Apache.

LITTLE ROCK, ARK.—Plans will be prepared by J. W. Bleidt, City Electrician, for an electric light plant with an output sufficient to supply electricity for 750 arc lamps, to cost $40,000. A 450-hp steam turbine will be installed, the cost of which is estimated at $16,000.

SAN FRANCISCO, CAL.—The power plant of the Great Western Power Company on the Feather River is nearly completed and will commence to furnish electricity in the northern part of the state in October. It is said that the entire output of this plant already has been contracted for, and announcement has been made that it has been decided that the power house would be enlarged to such a size that it will be capable of furnishing electricity throughout the state. This new investment will cost $25,000,000. The present plant cost about $12,000,000.

COLORADO SPRINGS, COL.—Plans are being made by the Colorado Springs Electric Company to install an engine, a 500-kw, three-phase generator, a motor generator, self-supporting stack and new switchboard in its plant, the cost of which is estimated at $60,000.

GRAND JUNCTION, COL.—It is understood that Morris K. Devereaux and Eugen S. Sunderlin will soon apply for a franchise to construct a street railway system in this city.

HARTFORD, CONN.—The Hartford Electric Light Company has purchased a 3500-kw, Westinghouse-Parsons, 2300-volt, three-phase turbo-generator set. This machine will be installed in the Dutch Point plant, which at present contains four turbines of the same make, aggregating 5500 kw.

DOVER, DEL.—The City Council has authorized the chief engineer of the water works system and electric light plant and the chairman of the water and light committee to make investigations preparatory to installing new engines and generators in the municipal electric light plant. A. L. Kichline is chief engineer.

KENTON, DEL.—The People's Telephone Company is erecting a telephone line between Kenton and Hartley, which later will be extended to Cheswold.

WASHINGTON, D. C.—President Roosevelt has signed the bill authorizing the Washington Railway & Electric Company and the Capitol Traction Company to extend their lines to the new terminal station temporarily.

WASHINGTON, D. C.—Bids will be received until June 18 by Bernard Green, superintendent of construction of building for National Museum, Library of Congress, Washington, D. C., for furnishing and delivering engines, including the installation of the same for the National Museum in Washington.

WASHINGTON, D. C.—Both the Senate and the House have passed over the President's veto the bill extending the time for the construction of a dam across the Rainy River in Minnesota. It was explained that the veto had been applied under a misapprehension, and that the President accordingly had withdrawn his objections.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Commissioners of District of Columbia, Washington, D. C., for furnishing and installing a 100-hp boiler and to make the necessary changes in the piping to connect up with the present plant and to furnish all necessary accessories at the power house at the Home of the Aged Infirm at Blue Plains. Specification and proposal blanks may be obtained at the above office. The commissioners are: H. B. F. Macfarland, Henry L. West and Jay J. Morrow.

KEY WEST, FLA.—The Key West Electric Light Company contemplates enlarging its power plant in this city and has secured options on the property adjoining its present power station, on which additions to the plant will be erected.

ST. ANDREWS, FLA.—The St. Andrews Light & Power Company, recently formed, will construct a plant here at a cost of about $12,000. Contracts for material have already been placed. T. J. McSween is engineer in charge.

TAMPA, FLA.—The Tampa Electric Company is contemplating an issue of $2,000,000 in bonds, the proceeds to be used to increase the equipment of its power plant and improving the electric lighting system.

MINIDOKA, IDAHO.—Specifications are on file at the office of the ELECTRICAL WORLD, 239 West Thirty-ninth Street, New York, N. Y., for electrical apparatus for the Minidoka project, Idaho, bids for which will be received until June 24 at the office of the United Reclamation Service, 777 Federal Building, Chicago, Ill.; also for turbines, pumps and accessories, bids for which will be opened at the same office on June 23. O. H. Ensign, 25 Carroll Block, Madison, Wis., is chief electrical engineer.

SANDPOINT, IDAHO.—Application has been made to the City Council for a franchise to construct an electric plant to furnish electricity for manufacturing purposes and to construct and operate an electric street railway system in this city. F. M. Molyneaux, A. Filson, V. M. McBride and Earl Farwin, of Sandpoint, and V. M. Smith, of Brooklyn, N. Y., are interested in the enterprise.

CHICAGO, ILL.—William Carroll, city electrician, according to local press reports, states that the city does not contemplate abandoning the municipal electric lighting plants, but is simply changing from steam to electrical power to drive its dynamos, and will continue to generate its own electricity.

DE KALB, ILL.—The De Kalb-Sycamore Interurban Traction Company is installing two 400-hp Wickes boilers, with Murphy automatic stokers. The company is also installing the Green Fuel Economizer Company's system of exhaust draft and has placed orders with the Economical Engineering & Construction Company, of Chicago, Ill., for vacuum ash and coal handling machinery.

MANITO, ILL.—The City Council is reported to have rejected all bids for the completion of the electric light plant. New bids will be received.

FT. WAYNE, IND.—An ordinance has been introduced in the City Council providing for placing of all wires underground in the central part of the city, except trolley wires.

GARY, IND.—The Gary-Hobart Traction Company has been chartered to build street and interurban railways in and between Gary, Liverpool and Hobart. L. C. Wood and others are the directors. The capital stock of the company is placed at $10,000.

MICHIGAN CITY, IND.—It is reported that a $1,000,000 power plant will be erected in this city by the Chicago, Lake Shore & South Bend Railway. The plant will furnish electrical power to operate the cars of the South Bend and Chicago road. It is understood the company contemplates the construction of a railway to Niles along the route of the Michigan Central and eventually to Kalamazoo, Mich.

DECORAH, IA.—The Standard Telephone Company contemplates placing its wires underground in this city.

DECORAH, IA.—The Upper Iowa Power Company has awarded the contract for the construction of its dam to Rich, Carlson & Feife.

LEHIGH, IA.—It is reported that an electric light plant will be installed here. H. V. Williams is interested in the project.

INDEPENDENCE, KAN.—The Union Traction Company, which contemplates the construction of an interurban electric railway between Arkansas City and Winfield, has been voted $20,000 in bonds by Arkansas City to aid in the construction of the railway. It is reported that a similar amount will soon be voted on in Winfield. D. H. Siggins, of Coffeyville, is president and general manager.

MOUNDRIDGE, KAN.—The question of establishing an electric light plant and water works system in the town is being considered. Plans are now being prepared by Burns & McDonnell, of Kansas City, Mo.

RUSSELL, KAN.—The citizens are considering the question of establishing an electric light plant and water works system in the town, for which plans are being prepared by Burns & McDonnell, of Kansas City, Mo.

SOLOMON, KAN.—Plans are being prepared by Burns & McDonnell, of Kansas City, Mo., for the construction of an electric light plant and water works system in this place.

KNOXVILLE, KY.—It is reported that the Knoxville, Sevierville & Eastern Railway Company will commence work on the construction of its road June 14, the bonds of Sevier County to the amount of $150,000 having been declared valid. W. J. Oliver & Company will build the line.

MAYFIELD, KY.—The plant of the Mayfield Water & Light Company is reported to have been destroyed by fire on May 17.

LISBON FALLS, MAINE.—The Lisbon Falls Gas & Electric Company has purchased a 100-kw, 2300-volt, alternating-current generator and switchboard for its power plant.

PRESQUE ISLE, MAINE.—Plans are being considered to have the Maine & New Brunswick Electrical Power Company extend its service outside of the village of Fort Fairfield, the territory to be served being reached by about 14 miles of pole line which was erected for the Independent Telephone Company, the poles not having been used.

LAUREL, MD.—The citizens have voted in favor of the proposition of issuing $15,000 in bonds for the construction of a new electric light plant.

THURMONT, MD.—F. C. Perkins has been granted a franchise to erect a power plant and to furnish electricity in this city, for which preliminary surveys have been made.

BOSTON, MASS.—The bill allowing the French King Rapids Power Company to construct a dam on the Connecticut River has passed the Massachusetts Senate.

BOSTON, MASS.—The supreme judicial court of Massachusetts has decided that the New York, New Haven & Hartford Railroad Company has not the right to hold stocks of electric railways in the state of Massachusetts. It is said that the company will obey the decree of the court. C. S. Mellen, president of the company.

CLINTON, MASS.—A committee has been appointed to investigate the matter of power development at the Wachusett Dam and the question of municipal ownership of the plants of the Clinton Gas Light Company, especially as to the cost they would be to the town, and report at an adjourned town meeting to be held July 13.

CLINTON, MASS.—Plans have been completed and bids have been called for the construction of a new power house for the Bigelow Carpet Company by Charles T. Main, of Boston, mill engineer and architect, which includes power, boiler and pump houses, stack and coal pocket. The equipment will consist of 2500 hp in boiler capacity and about 1100 kw in generating units.

DRACUT, MASS.—The citizens are considering the question of establishing an electric light plant.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company is moving its substation from the Berkshire Block annex to its plant on upper Main Street.

MILLERS FALLS, MASS.—The Village Council has adopted the following schedule of rates for electricity for motors. No power rates will be given for a motor of less than 2 hp, and that a minimum charge of $2 per month be made. The rates are: For the first 100 kw-hours per month, 7 cents per kw-hour; from 100 to 200 kw-hours, 6½ cents; from 200 to 400 kw-hours, 5½ cents, and for 600 or more kw-hours, 5 cents.

PELHAM, MASS.—A franchise has been granted to the Holyoke Street Railway Company for an extension of the Amherst & Sunderland branch to Orient Springs. W. L. Loomis is president.

SHREWSBURY, MASS.—The contract for installing the municipal electric light system has been awarded to the Delta Electric Company, of Worcester, for $11,159. The contract for electrical energy for operating the system has been awarded to the Marlboro Electric Company, for a term of five years. Under the terms of the contract the Marlboro company is to deliver electricity at 6600 volts, three phase, near the town hall, and is to maintain and erect the transmission line from its plant to the substation. A 24-hour service will be furnished.

MARQUETTE, MICH.—C. Retallic, superintendent of the municipal electric light and power plant, writes that bids will be received about June 15 for the construction of a substation in connection with the present power plant, the cost of which is estimated at $12,000. C. W. Humphrey, The Rookery, Chicago, Ill., is engineer.

OWOSSO, MICH.—Plans are being formulated by the Shiawassee Light & Power Company, of Coruna, to control the supply of electricity in this district. The company is negotiating for water rights along the Shiawassee River for a distance of 35 miles. An attempt is also to be made, it is said, to secure control of the local power plant and the transmission line between the two cities. The Owosso & Coruna Electric Company, which controls the electrical plant in Coruna, is now in the hands of a receiver.

REED CITY, MICH.—The plant and holdings of the Reed City Electric Light Company have been taken over by George D. Westover, H. Millspaugh, and E. J. Haynes, of Cadillac. The new company is capitalized at $30,000 and will be known as the Osceola Light & Power Company.

CLAREMONT, MINN.—This village is considering the question of installing an electric light plant at a cost of about $6,000.

SUNBEAM, MINN.—An independent telephone company is being organized in this town for the purpose of installing a telephone system from Sunbeam through the towns of Deer Park and Kratka to High Landing.

UNDERWOOD, MINN.—Plans are being made to organize an independent telephone company for the purpose of erecting a telephone line from Underwood to Phelps.

OXFORD, MISS.—The University of Mississippi has accepted the plans prepared by Engineer Prout, of Memphis, for the light and power plant for the University. The cost of the plant is estimated at $35,000. D. M. Kimbrough is a member of the building committee.

ARCOLA, MO.—The Kansas City & Springfield Southern Railway is contemplating the construction of a power house to furnish electrical energy for its railway. C. C. McFann, of Nevada, is general manager.

LOUISIANA, MO.—Plans are being considered by the Louisiana Light, Power & Traction Company to erect an electric power house and repair shops at Louisiana. F. E. Murray is secretary.

OREGON, MO.—Bids will be received by the Oregon Interurban Railway Company until June 10, for the construction of its road from Oregon to Forest City, Mo., a distance of 4½ miles. B. F. Morgan, of Oregon, is president.

BOZEMAN, MONT.—The Gallatin Valley Electric Railway is contemplating the construction of an electric railway from Bozeman to Salesville, a distance of 26 miles, for which preliminary surveys have been made and practically all the right of way secured. H. L. Casey is secretary, and C. N. Jacquette, of Bozeman, chief engineer.

WHITEFISH, MONT.—The Big Bend Light & Power Company has applied to the Town Council for a franchise to install an electric lighting plant in this place.

OMAHA, NEB.—The Omaha, Lincoln & Beatrice Railway Company is making arrangements to place contracts for the construction of about 1⅛ miles of track, with overhead equipment, etc.

ASHLAND, N. H.—Plans are being made by the Ashland Electric Light Company to install a new street lighting system, the equipment for which has already been ordered.

CONCORD, N. H.—The Concord Electric Company has purchased a 500-kw, 2300-volt, General Electric alternator. This machine will be installed to supplement the company's water power service.

GROVETON, N. H.—The Odell Manufacturing Company will shortly increase the equipment of its power plant by the installation of a 200-kw, General Electric, 600-volt alternator, with switchboard and several electric motors.

ASBURY, N. J.—The Atlantic Coast Electric Railway Company has applied to the City Council for a franchise to construct an electric railway from Florence Avenue to the Monmouth Beach Borough line in Long Branch.

JERSEY CITY, N. J.—The Board of Aldermen has passed an ordinance granting the Mutual Benefit Electric Light & Power Company permission to construct underground conduits in the streets of the city for the distribution of electricity for a term of 20 years.

PASSAIC, N. J.—A proposition has been submitted to the Board of Freeholders of the City of Passaic by Thomas N. McCarter, president of the Public Service Corporation, to supply electricity to light the streets of the city. The company offers to supply arc lamps during the term of the present contract, which will expire April, 1911, at the rate of $100 per lamp per year, except where lines have to be constructed to supply the lamps, when the rate will be $140 per lamp per year.

PRINCETON, N. J.—Plans are being made to enlarge the power plant at Princeton University. Two Boilers of 350 horse power, an engine and a 300-kw generator will be added. A new coal bunker will also be built. The cost of the work is estimated at $50,000.

WOODBURY, N. J.—The taxpayers have been asked to express their views at the next meeting of the Council to decide whether to enter into a five-year contract with the Public Service Corporation to light the streets of the town, instead of establishing a municipal electric light plant. The citizens favor expending $25,000, but Councilman Pearson declares, after investigation, that a plant cannot be built for that sum.

BABYLON, N. Y.—The Babylon Electric Light has filed wth the Secretary of State a notice of increase of capital stock from $15,000 to $45,000. L. H. Fishel is president of the company.

FAIRPORT, N. Y.—Plans are being made to improve the municipal electric light plant, which will include the installation of additional machinery. For further information address Dr. F. W. Clapp.

GENEVA, N. Y.—Bids will be received by Lyman P. Haviland, chairman of the building committee, State Agriculture Experiment Station, at Geneva, until June 20 for gas engine, dynamo, switchboard, motors, electric wiring, pole line and connections for the State Agriculture Experiment Station at Geneva. Drawings and specifications may be seen and blank forms of proposals obtained at the office of the director at Geneva, or at the office of the State Architect, Albany. Complete plans will be furnished to prospective bidders upon application to Franklin B. Ware, state architect, Albany, N. Y.

HUDSON, N. Y.—The City Council has awarded the contract for lighting the streets and city hall building for a term of five years to the Albany & Hudson Railroad Company, commencing Sept. 15, 1908. Under the terms of the contract the company is to furnish arc lamps of 2000 cp at the rate of $81.75 per lamp per year, and incandescent lamps of 22 cp at $22 each per year. The street lighting system consists of 117 arc lamps and 15 incandescent lamps.

NEW YORK, N. Y.—Bids will be received by J. W. Stevenson, commissioner of bridges, until June 11 for electrical equipment of the University Heights Bridge.

NEW YORK, N. Y.—The contract for installing electric equipment in new School No. 100, Borough of Manhattan, has been awarded to T. Frederick Jackson, 592 Columbus Avenue, Manhattan, for $16,600.

NEW YORK, N. Y.—Bids will be received until June 8 by C. B. J. Snyder, superintendent of school buildings, for installing electric equipment in additions to and alterations in Public School No. 64, Borough of Brooklyn.

NIAGARA FALLS, N. Y.—It is reported that the Erie Railroad will equip its road to be operated by electricity between Niagara Falls and Buffalo. W. Carl Ely, formerly of this city, is said to be forming a syndicate to take charge of the work.

VALLEY CITY, N. D.—Bids will be received by the City Council until July 6, for the sale of the municipal electric light plant. A 20-year exclusive franchise will be granted to the successful bidder. Bids for less than $40,000 will not be considered. H. F. Halverson is city auditor.

CINCINNATI, OHIO.—Plans are being considered by Dr. H. T. George, of Dayton, to establish a new traction railway to connect Cincinnati and Fort Wayne, Ind. It is proposed to use the old Gamble Road, extending from Brighton to Cheviot, as a means to enter Cincinnati.

CINCINNATI, OHIO.—Governor Harris has permitted the Hunt bill to become a law without signing it. The bill authorizes the construction of a rapid transit overhead and underground railway from Third and Walnut Streets in Cincinnati to Norwood, and, it is said, provides a means of entrance for interurban lines.

COLUMBUS, OHIO.—Plans have been approved by the State Tuberculosis Hospital Commission for a power house and several other buildings for the new hospital located near Mt. Vernon. The State Legislature made an appropriation last winter of $350,000 for extensive improvements to the hospital, including the construction of a power plant to furnish light and heat, water works, several new buildings, etc. Dr. C. D. Probst is secretary of the commission.

ELYRIA, OHIO.—The electric lighting plant of the Elyria Milling & Power Company has been completed and will soon be put in operation. The plant will furnish electricity for street lamps.

LEWISBURG, OHIO.—Bids will be received until July 1 for the construction of an electric light plant and water works system to cost $26,000. The plant will be operated by gasoline engines. Harry J. McDargh, of Dayton, is engineer.

NEW PHILADELPHIA, OHIO.—It is reported that the Columbus, Canton & Eastern Transit Company, recently incorporated, will take over the holding of the Valley Transit Light & Power Company, of New Philadelphia, and also proposes to construct an electric railway from Canton to Columbus, for which much of the right of way has been secured. W. W. Snyder, of New Uhrichsville; Michael Seibold, W. J. Wise, Frank G. Kunzl, A. W. Reiser, J. Knisely and others of New Philadelphia are interested in the project.

YOUNGSTOWN, OHIO.—The ordinance recently passed by the City Council giving the Youngstown Consolidated Gas & Electric Company permission to furnish street lighting has been reconsidered, and the proposition will be taken up in connection with the agitation for lower street railway fares.

GUTHRIE, OKLA.—An appropriation has been made by the State Legislature for the construction of a heat, light and ice plant for the Fort Supply Asylum.

EL RENO, OKLA.—E. E. Blake has filed on water rights to construct a canal for irrigation and power purposes. The cost of the work is estimated at $25,000.

SHAWNEE, OKLA.—The Chamber of Commerce and business men of Shawnee have pledged a bonus of $75,000 to any company that will build an electric railway from Shawnee to Muskogee. Okmulgee and Okemah have also pledged $25,000 each.

ALBANY, ORE.—A franchise has been granted to the Portland, Eugene & Eastern Railway Company to construct an electric railway on Ellsworth Street to connect with the Ninth Street line. A. Welch is general manager.

PANAMA.—Bids will be received until June 24 at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., for boiler room equipment, consisting of boilers, fittings and appurtenances, uptakes, breeching, duplicate induced draft fans with direct-coupled turbine and motor, feed-water heater, boiler-feed pumps, piping, valves, pipe covering, etc. Lieut. Col. H. F. Hodges is purchasing agent.

BALFOUR, PA.—An independent telephone company has been organized here to construct a telephone line from Balfour to Carlisle. L. B. Brehm is president of the company.

BIRDSBORO, PA.—The Conestoga Telephone Company contemplates the construction of a telephone line from Churchtown to Bowmanville.

DUNBAR, PA.—Plans are being considered by the Tri-State Telephone Company for the installation of a cable plant at Dunbar, the cost of which is estimated at $8,000.

HUNTINGDON, PA.—It is reported that F. M. Bollinger and M. A. Miller are planning to organize a company for the purpose of constructing a street railway system in Huntingdon and up Stone Creek, a distance of about 2½ miles, where it is proposed to establish an amusement park. It is said that a charter will be soon applied for under the name of the Brookside Electric Railway.

IRWIN, PA.—The Irwin-Herminie Electric Railway Company has been granted a franchise to operate its cars on certain streets of the borough, for the privilege of which the company is to pay the borough over $8,000. Work is to be started within 60 days and to be completed within one year.

LAVELLE, PA.—An independent telephone company has been organized in this city to construct a telephone line to connect with the independent system at Locust Dale.

MANOR, PA.—The Manor Valley Electric Railway Company has applied for a charter and proposes to construct an electric railway from Manor to Export, a distance of seven miles. H. A. Lauffer, of Manor, is president.

SUNBURY, PA.—The Sunbury & Northumberland Electric Railway Company is in the market for overhead material and for 6000 ft. standard track. R. West is general manager.

PROVIDENCE, R. I.—The Providence Telephone Company has been granted permission to place its wires underground on certain streets in the city.

WOONSOCKET, R. I.—The City Council has voted against the approval of the proposed merger act incorporating the Blackstone Valley Electric Light & Gas Company as a holding company for the two Woonsocket and two Pawtucket lighting companies. It is stated that the merger would be effected under a New Jersey or Maine charter.

SPARTANBURG, S. C.—The Electric Power & Manufacturing Company contemplates extending its transmission lines to the surrounding mill towns. F. D. McEwen is vice-president and general manager. This company recently purchased the plant and holdings of the Spartanburg Street Railway, Gas & Electric Company.

WOODRUFF, S. C.—A movement has been started by the business men of this town to organize a public utility company for the purpose of purchasing electricity from the Electric Power & Development Company and distributing it to the citizens. The Electric Power & Development Company will extend its transmission line from Spartanburg to Woodruff.

CARTHAGE, TENN.—The citizens are considering the question of establishing an electric light plant.

PULASKI, TENN.—J. H. Ragsdale and associates are interested in a project to develop water power on the Elk River to generate electricity, which will be transmitted to Pulaski and other towns.

BRENHAM, TEX.—The County Commissioners have granted franchises to the Brenham & Long Point Telephone Company and to the Chappell Hill Telephone Company to erect telephone lines along the public highways.

FLORESVILLE, TEX.—The Cestahowa Telephone Company has been granted a franchise to erect telephone lines along certain public roads in Wilson County.

DANVILLE, VA.—The city is contemplating the construction of a new municipal electric light plant at a cost of $150,000. Frank Talbott is superintendent.

CENTRALIA, WASH.—An election will be held June 2 to vote on the proposition of issuing $45,000 in bonds, the proceeds to be used to purchase an electric light plant. The city already owns its distributing system, but has purchased electricity to operate the system, the contract for which will expire in about a year.

CHEHALIS, WASH.—A notice of appropriation of water rights on Winston Creek, near Mayfield, has been filed by E. Riggs, of the Chehalis Light & Power Company. It is proposed to develop the water power to operate the electric plant, street railway system, etc.

HUNTERS, WASH.—A. Newell and J. T. Young are developing water power at this place to furnish power to operate an electric light plant in connection with their fruit box factory.

SEATTLE, WASH.—E. B. Cox, manager of the Golden Gardens, contemplates installing electric lamps in the streets of Loyal Heights north of Ballard, and will soon apply to the County Commissioners for a franchise to erect the system.

TACOMA, WASH.—The City Council on May 15 voted to instruct the Commissioner of Public Works to advertise for bids for furnishing the city 1500 additional horse-power in connection with the municipal lighting plant for a term of 4½ years.

VASHON, WASH.—The Vashon Island Telephone Company has been granted a franchise by the County Commissioners to erect telephone lines along the county roads and to lay a cable from Fauntleroy Cove to Dolphin Point, and along the beach. A franchise was also granted to A. W. Davis to erect telephone lines over certain streets at Redondo Beach.

FAIRMONT, W. VA.—A special meeting of the stockholders of the Fairmont & Clarksburg Traction Company will be held June 10 to vote on the proposition of increasing the capital stock from $2,000,000 to $5,000,000. The company proposes to establish an interurban system connecting the important towns in eastern West Virginia. S. L. Watson is president of the company.

EAU CLAIRE, WIS.—The City Council has accepted the bid of the Chippewa Valley Railway, Light & Power Company to light the streets of the city. Under the terms of the contract the company is to furnish 140 arc lamps at a cost of $56.40 per lamp per year.

JUNEAU, WIS.—W. G. Kirchoffer, of Madison, engineer, writes that all bids received April 18 for the construction of power house, and for furnishing a 300-gal. deep well triplex pump and a 25-hp gasoline engine have been rejected, and as yet nothing further has been done.

KEWAUNEE, WIS.—The citizens have voted to issue $20,000 in bonds to establish an electric light plant.

LA CROSSE, WIS.—Plans are being considered by the La Crosse Water Power Company, which has just completed a 16,000-hp hydro-electric plant at Hatfield, for the construction of another plant below Hatfield. Orland Holway, who was the promoter of the Hatfield plant, is now engaged in the preliminary work. It is proposed to construct another dam at Levis Island. It is said that a new company will be organized to build the new power plant, which will be located about two miles above the city.

NEW WESTMINSTER, B. C., CAN.—Arrangements are being made by the Canadian Pacific Railway Company to equip its road between here and Westminster Junction, to be operated by electricity, early next year. F. E. Busteed, of Vancouver, is general superintendent.

VICTORIA, B. C., CAN.—Bids will be received by W. W. Northcott, civic purchasing agent, until June 15 for two electrically driven water pumps for the civic water works system.

SYDNEY, N. S., CAN.—The City Council has decided to extend the municipal street railway system.

YARMOUTH, N. S., CAN.—Plans are being made by the Yarmouth Street Railway Company to purchase a 300-kw generator, turbines and hydraulic equipment. The company recently purchased a 150-hp Robb-Armstrong engine and a 100-kw Canadian General Electric alternator.

BELLEVILLE, ONT., CAN.—Mayor McFee has refused to sign the application made by the City Council to the Ottawa Government for the sole right to develop power on dams 3, 4 and 5 on the Trent Valley Canal.

DUNNVILLE, ONT., CAN.—The citizens have voted in favor of the by-law to purchase $30,000 of the Dunnville, Wellandport & Beamsville Railway bonds to assist in the construction of that railway.

HUNTSVILLE, ONT., CAN.—The town is considering the question of establishing a municipal electric plant and has engaged C. H. Mitchell, of Toronto, to make investigation for power development in connection with the plant.

LONDON, ONT., CAN.—The Power Committee appointed by the city to investigate the Hydro-Electric Power project, finds that under the provision of the Niagara contract the City of London would be liable for the sum of $702,658 for 30 years. The city's proportion of the cost of the transmission line, cost of operation, etc., would be $31,578, and a distributing plant would cost about $300,000, making the total cost over $1,000,000.

OAKVILLE, ONT., CAN.—Arrangements have been made by the town to install a new electric lighting plant, electrical energy for which will be supplied by the Radial Railway Company. Electricity for all purposes will be supplied on a meter basis, and meters will be supplied to all customers without charge. The company, it is said, will apply for a charter to supply electricity for motors.

PORT ARTHUR, ONT., CAN.—The civic power plant was destroyed by the bursting of the dam on Current River. J. J. Carrick is Mayor.

PORT ARTHUR, ONT., CAN.—The City Council has voted $40,000 for extensions to the municipal electric street railway system. J. J. Carrick is Mayor.

STRATFORD, ONT., CAN.—The City Council has decided to submit another by-law to the people to make a contract with the Hydro-Electric Power Commission for electrical energy.

MONTREAL, QUE., CAN.—The City Council has decided to accept the offer of the Robert Company to supply electricity in the city for lamps and motors. The new company will develop the Beauharnois Canal, and offers to furnish electrical energy at a cheaper rate than is now supplied by the Montreal Light, Heat & Power Company. E. A. Robert, E. B. Greenshields, G. G. Foster, and others are interested in the enterprise.

PRINCE ALBERT, SASK., CAN.—The City Council has decided to replace the present street lamps with arc lamps. The Council is contemplating utilizing the old electric light plant for a power house to furnish electrical energy for an electric railway system to be owned by the municipality.

SPRINGSIDE, SASK., CAN.—Plans are being made by the Yorkton Northwest Telephone Company to construct a telephone system in this city.

New Industrial Companies.

THE STOLZ ELECTROPHONE COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 by Ernest H. Stolz, Frederick K. Gustin and Albert E. Coy. The company proposes to manufacture instruments to improve the hearing.

THE FEDERAL LIGHT & SUPPLY COMPANY, of Milwaukee, Wis., has been incorporated, with a capital stock of $5,000, to deal in lighting apparatus, etc. The incorporators are: Charles F. Meinhard. Ernest Kruecke and Robert Kruecke.

THE BELMONT ELECTRIC COMPANY, of New York, N. Y., has been chartered with a capital stock of $1,000, to manufacture electrical supplies. The incorporators are: Thomas W. McKnight, John W. O'Hara and John B. Brown, of New York, N. Y.

THE GLAISTER COMPANY, of Montclair, N. J., has been incorporated with a capital stock of $20,000 to do a general electrical contracting and supply business. The incorporators are: H. M. Browne, E. J. Forhan, both of New York, N. Y., and F. W. Mills, of Hoboken, N. J.

THE MILLER-WARREN COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $5,000, and proposes to manufacture engines, boilers, machines, tools, etc. The incorporators are: William J. Schatz, Daniel Miller and Edward Warren, all of New York, N. Y.

THE MORRIS GETTER ELECTRICAL COMPANY, of New York, N. Y., has been chartered by Marcus Getter, Joseph Getter, Solomon Blaine and William Helfaud, all of New York, N. Y. The company is capitalized at $5,000 and proposes to do a general electrical supply and contracting business.

O. HUMMEL & SONS, of New York, N. Y., have filed articles of incorporation with a capital stock of $10,000, for the purpose of manufacturing machinery, engines and electrical appliances. The incorporators are: H. Leroy Bell, Robert D. Geswein, George W. Collins, all of New York, N. Y.

THE JAMES J. HAROLD MANUFACTURING COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $10,000, by James J. Harold, Emma Harold and Charles W. Harold, all of Brooklyn, N. Y. The company proposes to manufacture engines, dynamos, pumps, etc.

THE STORAGE BATTERY LIGHTING COMPANY, of Augusta, Maine, has been incorporated, with a capital stock of $1,200,000, for the purpose of manufacturing storage batteries. The officers of the company are: E. E. Newbert, of Augusta, president; J. Berry, of Augusta, treasurer, and M. H. Simmons, of Hallowell, clerk.

Company Elections.

WASHINGTON, D. C.—At a meeting of the directors of the Washington Railway & Electric Company, held May 28, the following named officers were elected: Clarence F. Norment, president; Ward Thoron, first vice-president; George H. Harries, second vice-president, and Allan L. McDermott, special counsel.

GAINESVILLE, GA.—At the annual meeting of the North Georgia Electric Company the following named officers were elected: W. A. Carlisle, of Gainesville, president; C. M. Merrick, of New Brighton, vice-president; W. H. Slack, of Gainesville, secretary and treasurer.

GAINESVILLE, GA.—At the annual meeting of the Gainesville Electric Railway Company the following named officers were elected: A. G. Sharp, of Atlanta, president; J. F. Moore, of Dahlonega, vice-president; W. H. Slack, of Gainesville, secretary and treasurer, and W. A. Carlisle, manager.

CHICAGO, ILL.—At the annual meeting of the Calumet & Chicago Railway Company the following named officers were elected: Ira M. Cobe, president; D. M. Cummings, vice-president; O. S. Gaither, secretary and treasurer.

QUINCY, ILL.—At the annual meeting of the St. Louis, Terre Haute & Quincy Interurban Railway the following named officers were elected: Edward Yates, of Pittsfield, Ill., president; W. C. Flick, of Quincy, Ill., vice-president; F. W. Knollenberg, of Quincy, Ill., secretary; S. P. Landeraft, of Quincy, Ill., treasurer. It is said that arrangements have been made for financing the project, and that work will soon commence on the construction of the road between this city and Taylorville, surveys for which have already been made.

SOUTH BEND, IND.—At the annual meeting of the stockholders of the Indiana & Michigan Electric Company the following directors were elected: Chas. A. Chapin, of Chicago, Ill.; M. L. Howell, of Cassopolis; F. A. Bryan, South Bend; A. A. Pope, of Cleveland, Ohio; E. A. Sanders, of Mishawaka; H. L. Crawford and H. H. Porter, of New York, N. Y. The directors re-elected the present officers.

IOLA, KAN.—At the annual meeting of the Crouch Electric Railway Company the following named officers were elected: F. V. Crouch, president; J. H. Osborn, vice-president; S. J. Stewart, secretary, and C. A. Bowlus, treasurer.

PAWTUCKET, R. I.—At the annual meeting of the Pawtucket Electric Company Fred W. Eaton was elected president of the company. The other officers of the company were re-elected.

New Incorporations.

CALLAHAN, CAL.—The Callahan Telephone Company has been organized for the purpose of erecting a telephone line to Gazelle, a distance of 28 miles. F. A. Grant is president of the company and F. W Armstrong, secretary.

PT. RICHMOND, CAL.—The Bay Shore Electric Light & Power Company has been incorporated, with a capital stock of $500,000, by W. H. George, of San Francisco; M. R. Jones, of Martinez; A. E. Steinberg, of Port Costa; E. M. Downer and L. E. Hart, of Pringle.

EAST ST. LOUIS, ILL.—The Duto Telephone Company has been organized with a capital stock of $10,000, by L. Beauman, W. S. Dorman, L. O. Whitnel and others.

HOPEDALE, ILL.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $20,000.

CROWNPOINT, IND.—Articles of incorporation have been filed for the Gary & Southern Traction Company by John W. Brown and others. The company is capitalized at $10,000 and proposes to build an electric railway between this city and Gary.

INDIANAPOLIS, IND.—The Indianapolis, Cloverdale & Terre Haute Traction Company has been incorporated by E. M. Bowman, H. F. Butze, Samuel T. Axtell, W. L. Cook and H. C. Sandresky. The company proposes to construct and operate a traction line connecting Indianapolis, Terre Haute and intervening cities.

POSEYVILLE, IND.—The Poseyville Light & Power Company has filed articles of incorporation for the purpose of constructing and operat-

ing an electric light plant in this place. The capital stock is placed at $10,000, and the directors are: Frank K. Seib, August Seib, Joseph F. Shaffer, Herman Stallings and Martin Dilger.

MASON CITY, IOWA,—The Idlewild Telephone Company has filed articles of incorporation with a capital stock of $10,000. The officers of the company are: W. W. Wilkinson, president; Dennis O'Donnell, vice-president; Ernest Stevens, secretary and treasurer.

ARMINTA, KY.—The Arminta Telephone Company has been organized with a capital stock of $500 by J. D. Blair, James Hall, J. H. Blair and others. J. D. Blair is manager.

HUSTONVILLE, KY.—The Hustonville Telephone Company has been organized with a capital stock of $500, by D. G. Kelly and others. The company proposes to erect telephone lines from this city to Mt. Vernon, a distance of about 40 miles.

STANFORD, KY.—The Farmers Telephone Company has been formed with a capital stock of $1,000 by A. K. Caldwell, M. F. Campbell, Tipton Simms and others.

CLARISSA, MINN.—The Eagle Valley Telephone Company has been organized for the purpose of erecting a rural telephone system. Peter Holmquist is secretary.

VICKSBURG, MISS.—Articles of incorporation have been filed for the Vicksburg Traction Company by S. S. Bullis and J. W. Cassell, of Vicksburg. The company is capitalized at $10,000 and proposes to operate an electric railway in Vicksburg.

EXCELSIOR SPRINGS, MO.—Articles of incorporation have been filed for the Excelsior Springs & Suburban Railway Company by Allen M. Bates, Hugh Wilhite and W. P. Southard, of Excelsior Springs; Henry J. Arnold, of Denver, Col., and John Lundstrain, of Colorado Springs. The company is capitalized at $50,000.

SHELBINA, MO.—Articles of incorporation have been filed for the Shelbina Telephone Company with a capital stock of $30,000, by J. H. Wood, S. A. Wood, V. E. Durham, G. C. Carnahan and W. S. Wood.

PORTALES, N. M.—The Roosevelt County Telephone Company has been incorporated with a capital stock of $25,000.

EMERADO, N. D.—The Emerado Rural Telephone Company has been chartered with a capital stock of $50,000, by J. K. Buttery, James Finnie and William Leake, all of Emerado.

LANGDON, N. D.—The Langdon Telephone Company has been incorporated with a capital stock of $25,000, by H. D. Albert, R. T. Burke, L. Allert and M. Burke, all of Langdon.

NELSONVILLE, OHIO.—Articles of incorporation have been filed for the Nelsonville & Murray Home Telephone Company with a capital stock of $50,000, by Elmer O. Pettit, J. W. Jones, J. G. Collins, John Eicker, Jr., and John A. Wellman.

SPRINGFIELD, OHIO.—The Springfield & Washington Railway Company has been incorporated to construct a railway connecting Springfield, Washington C. H. and Chillicothe. The capital stock of the company is placed at $1,000,000, and the incorporators are: George W. Baker, Hiram C. Baker, Charles Baughton, W. E. Roderick, Ulric Sloane and W. W. Keifer. The property of the Washington Traction Company was recently purchased by Mr. Baker, and the new company has been organized to complete the road according to the original plans. The company is now operating between Springfield and South Charleston.

BARNEY, OKLA.—The Barney Telephone Company has been incorporated with a capital stock of $10,000, by Harry O'Neale, O. J. Struble, H. E. Chrislet, James Llewellyn and A. V. Kelly.

CHANEY, OKLA.—The Chaney Mutual Telephone Company has been organized with a capital stock of $6,000, by J. W. Fiegel, W. S. Wood, M. A. Griffith and J. L. Leist.

CHOTEAU, OKLA.—The Choteau Telephone Company has been chartered with a capital stock of $1,500, by W. A. Crokett, C. B. Lindsey, M. E. Adkins, W. E. Grant and A. F. Hennigh.

LA CROSSE, OKLA.—Articles of incorporation have been filed for the La Crosse Telephone Company. The capital stock of the company is placed at $1,000 and the incorporators are: C. Timkin, Frank Bartell, Samuel O'Dore, of La Crosse; J. H. Connet, of Pocasset, and G. A. Smith, of Verden.

RALSTON, OKLA.—The Big Bend Rural Telephone Company has been chartered, with a capital stock of $1,300, by P. D. Gilliland, of Failfax; E. A. Williams, C. Triplett and J. B. Covert, all of Ralston.

TEXOLA, OKLA.—The Walker Telephone Company has been organized with a capital stock of $10,000, by J. E. Walker, of Texola; Rea Blossom and B. B. Walker, of Shamrock, Tex.

ALBANY, ORE.—The North Albany Telephone Company has been organized by the farmers of Benton County, and the following named officers elected: M. Gibson, president; Edward Peacock, secretary and treasurer.

TURNER, ORE.—Articles of incorporation have been filed for the Battle Creek Telephone Company by Charles H. Cannon, James R. Coleman and W. B. Clark. The company is capitalized at $2,000.

BETHEL, PA.—The Bethel & Mt. Aetna Telephone & Telegraph Company has been organized by A. A. Spannuth, Harry R. Miller, R. I. Franz and others.

AMARILLO, TEX.—Articles of incorporation have been filed for the Panhandle Telegraph & Telephone Company with a capital stock of $500,000 to construct an exchange at Amarillo, and long-distance lines into the surrounding country.

RICHMOND, VA.—The Three Springs Telephone Company, of Three Springs, Va., has been incorporated with a capital stock of $5,000. The officers of the company are as follows: W. K. Shankle, president; J. P. Rumley, vice-president and secretary, and F. P. Shankle, treasurer, all of Bristol, Va.

ALEXANDER, W. VA.—The Alexander & Eastern Railway Company has been incorporated, with a capital stock of $100,000, by John B. Hart and Charles M. Hart, of Clarksburg. The company proposes to construct an electric railway from Alexander to Elkins, a distance of between 25 and 30 miles.

SISTERSVILLE, W. VA.—The Union Traction Company has been incorporated, with a capital stock of $150,000, to build an electric railway from a point near the boundary of Wetzel and Marshall Counties to New Martinsville and St. Marys and intervening cities. The incorporators are H. W. McCoy, G. E. Work, S. G. Messer and R. Broadwater, of Sistersville; I. D. Morgan and E. L. Robinson, of New Martinsville. This company is successor to the Wetzel & Tyler Railway. E. L. Robinson is general manager.

BALSAM LAKE, WIS.—The McKinley Telephone Company has been organized to construct a telephone line from McKinley to Cumberland. The officers of the company are: E. J. Pfluger, president; Israel Risberg, vice-president; Anton Lundmark, secretary and manager, and Oscar Risberg, treasurer.

LANG, SASK., CAN.—Five rural telephone companies have been organized in this city under the name of the Lang Farmers' Mutual Telephone Company, the companies being numbered from one to five. Each company will be capitalized at $1,200. The officers of the companies are as follows: No. 1—C. W. Frank, president; H. Downing, secretary and treasurer. No. 2—Wilfred Bowron, president; W. A. Bovair, secretary and treasurer. No. 3—J. M. Bradbury, president; H. M. Graham, secretary and treasurer. No. 4—Joseph Howard, president; J. J. Howard, secretary and treasurer. No. 5—O. B. McCumber, president; E. S. Kinter, secretary and treasurer.

LUMSDEN, SASK., CAN.—The Lumsden Radical Telephone Company has been organized to build and operate a telephone system in this city. The company has applied for a 25-year franchise.

SALTCOATS, SASK., CAN.—Articles of incorporation have been filed for the Saltcoats Telephone Company with a capital stock of $25,000. About 50 miles of line will be erected. W. H. Hallett is secretary and treasurer, and Dr. Softly, manager.

YELLOW GRASS, SASK., CAN.—The Yellow Grass Telephone Company has been formed with a capital stock of $20,000.

Legal.

FRANCHISE SALE ENJOINED.—Judge Samuel B. Kirby, of the chancery court, on May 11, on application of the Kentucky Electric Company, granted a temporary injunction against the Board of Public Works, and the City of Louisville to prevent the selling of the Fetter franchise, created by a recent ordinance of the General Council. In his opinion Chancellor Kirby says: "The ordinance was never legally passed by the Board of Councilmen; it is void because it delegates to the Board of Public Works powers which can only be exercised by the General Council; it excludes bidders who, under the law, have the right to bid at the sale in violation of Section 164 of the Constitution; it is so framed that no one save the George G. Fetter Company can bid at the sale or comply with the terms of the franchise; it impairs the obligation of the contract between the Kentucky Electric Company and the City of Louisville."

CONSTRUCTION OF GRANT TO OPERATE TELEPHONE LINE.—A deed to a water company, having no right in its corporate capacity to operate a telegraph or telephone line, except as it might be incidental to the purposes of a water company, granted a right of way for the laying of water pipes, "with the right to set up, operate and maintain a telegraph or telephone line or lines theron and with the right of ingress and egress to and from such right of way for all purposes." Afterward the water company assigned its rights to a telephone company which attempted to operate a commercial telephone line over the property. It was held that the clauses relating to the telegraph or telephone lines, and to the right of ingress and egress, were consistent with and incidental to the principal object of the grant for the construction and maintenance of the water plant, and imposed upon the land in question only the burden resulting from such telegraph and telephone lines as might be reasonably adequate for the purpose of constructing and maintaining the pipe lines authorized by the grant, and hence was not broad enough to confer on a telephone company holding under an assignment from the water company the right to use such right of way for the maintenance of a commercial telephone line. The grant of the right to maintain a telephone line contemplated only such a line as was incidental to the business of the water company, and was not sufficient to permit the assignee of the water company to engage in the business of operating a telephone line with unlimited wires. Northeastern Telephone & Telegraph Co. v. Hephon, Court of Errors & Appeals of New Jersey, 69 Atl. 249.

MUNICIPAL CONSENT TO ERECTION OF TELEPHONE LINE CANNOT BE WITHDRAWN.—A domestic telephone company applied to a city for a permit to construct and operate its line in the city.

At a special meeting of the council, at which the Mayor and six of the eight Aldermen were present, an ordinance granting the permit was presented and read the first time by unanimous consent. At the next regular meeting the ordinance was adopted. It was approved by the Mayor and duly recorded and published. Immediately thereafter the company, relying on the permission, began the construction of a telephone line along the route designed by the city officials, and completed an equipment for the establishment of a telephone system. The special meeting of the council was irregular, in that notice of it had not been given to the absent Aldermen, and it was held pursuant to an ordinance relating to special meetings which had never been legally adopted. On this ground the city attempted to withdraw the consent given to the company by the ordinance. It was held that, in view of the large sums of money expended by the telephone company in erecting its lines in reliance upon the validity of the ordinance, the city was stopped from withdrawing its consent. The right of a telephone company to erect its lines anywhere in a state includes the right to enter any city with the consent of its local authorities, and when such consent has been obtained the company is subject only to such rules and regulations as the Legislature may prescribe or authorize the council to prescribe. The right thus conferred upon a telephone company by the state—its franchise—is, of course, subject to control by the Legislature, but the consent of the municipality, once given, cannot be withdrawn. Missouri River Telephone Co. v. City of Mitchell, Supreme Court of South Dakota, 116 N. W., 67.

Personal.

MR. H. B. KIRKLAND, for many years one of the foremost men in the commercial field of electricity, has formed the H. B. Kirkland Company, which will hereafter act as selling agent for the National Metal Company, with headquarters in the Postal Telegraph Building, New York City. Three generations of Kirklands have been active in the American electrical field. Mr. Kirkland's father was one of the first successful developers of nickel plate, and the formula of quadruple silver plating used by several of the largest manufacturers resulted from his experiments. Mr. Kirkland's mother's father was connected with the construction of the first telegraph line between Baltimore and Washington. He afterward had a large share in constructing and operating the Atlantic & Pacific, Continental, Bankers' & Merchants', and American Rapid Telegraph companies; and at the time of his death had in hand contracts for several important long-distance telephone lines. "Harry" Kirkland was born in Boston in 1871, and entered the service of electricity as a messenger boy for the Continental Telegraph Company of Philadelphia. He later became engaged in the construction business, spending some years with the Marr Construction Company. He engaged in the construction of various central station plants throughout the United States, and then took up inside wiring in New York City in 1888-9. In 1892 he saw the possibilities of the conduit business and took it up, and has ever since remained active in that line except for one brief season. Having a strong histrionic taste, he sought to satisfy his craving for the stage by taking charge of the mechanical department for Julia Marlowe, but was soon more than pleased to resume his connection with the interior conduit industry. Mr. Kirkland is an associate member of the American Institute of Electrical Engineers, and a member of the Engineers' Club; while he is prominent also in several engineering, commercial and social organizations. His associate, Mr. Charles F. Boynton, has served the city in the capacity of chief electrical inspector for some 10 years, and served with distinction in the Seventy-first Regiment, taking part in the battle of Santiago.

H. B. KIRKLAND.

MR. N. F. BRADY.—On Wednesday evening, May 25, Mr. and Mrs. N. F. Brady gave a dinner at their home on upper Fifth Avenue to Cardinal Logue, of Ireland. Among those present on this interesting occasion were Archbishop Farley, Mr. and Mrs. A. N. Brady, Mr. and Mrs. Hugh J. Grant, Mr. and Mrs. T. E. Murray, Mr. and Mrs. J. W. Lieb, Jr., Mr. and Mrs. George J. Gillespie, Mr. and Mrs. Raymond Almirall, Mr. and Mrs. Henry J. Hemmens, Dr. and Mrs. John Jackson, Mr. and Mrs. Lyttleton Fox, Mr. John D. Crimmins, Judge Edward J. Garvan. The dinner was a purely social function, but at its close speeches were made by Cardinal Logue, Monsignor Lavelle and Father Pardow. The cardinal visited the great power house of the New York Edison Company on June 1 accompanied by Archbishop Farley, the secretary to the Cardinal, Rev. Father Quinn, and Messrs. Murray and Lieb of the Edison Company. The party was conducted through the Riverside stations by Mr. J. P. Sparrow, chief engineer, and Mr. W. H. Lawrence, electrical superintendent. The visitors were interested in many of the operating details of the plants, particularly the coal-hoisting towers. They watched with great interest the hoisting of the coal from the barges alongside the docks to the coal-hoisting towers 180 ft. above. A visit was also paid to the Twenty-seventh Street substation of the company where the party inspected the auditorium, library and reading rooms provided for the use of employees. They were greatly interested in the welfare work of the company and in the educational courses which have been instituted for the instruction of its employees.

DR. HENRY T. BOVEY, dean of the faculty of applied science at McGill University, is to deliver the commencement address at Johns Hopkins University on June 9. He will leave shortly thereafter for England to take up his new duties as rector of the Imperial College of Science and Technology, recently created in England, for post-graduate work, with headquarters at South Kensington.

MR. HERBERT LAWS WEBB has returned to London afteer a short visit to this country.

Obituary.

MR. W. A. PEARSON.—Mr. William A. Pearson, for 16 years chief architect and superintendent of buildings for the General Electric Company, at Schenectady, N. Y., died at his home in that city on May 26, after a lingering illness. He was born at Athens, Bradford County, Pa., July 29, 1855, where he received his early education. He was graduated from the Sayre, Pa., High School in 1870, and served his apprenticeship in the machinist's trade in the D., L. & W. Railroad shops in Scranton, Pa., where he was soon made foreman. He served with the Union Pacific Railroad as civil engineer for three years in Omaha, Neb., and afterward was promoted to master mechanic, with headquarters in Carson City, Nev. He then went to Virginia City, where he became superintendent of the Comstock mines, but resigned to engage in mining business with headquarters in New York. He afterward became superintendent of the marine department of the Dickson Manufacturing Company in Scranton, Pa., and later occupied a similar position with the Boies Wheel Company in the same city. His connection with the General Electric Company followed. Mr. Pearson was affiliated with the local Masonic bodies and at the time of his death was a member of St. George's Lodge, No. 6, F. and A. M.; St. George's Chapter, No. 157, R. A. M., and St. George's Commandery, No. 37, Knight Templars. He was also a member of the Royal Arcanum, and a member and officer of the First Presbyterian Church. He married in 1885 Miss Mary Burns, who died a year later, and in 1888 he married Miss Helen Franklin, who died in 1896. The interment took place at Scranton on May 28.

PROF. W. A. ANTHONY.—Prof. William Arnold Anthony, professor emeritus of physics and electrical engineering in Cooper Institute, New York, died at his home in that city, Friday, May 29, of heart disease, at the age of 73 years. Prof. Anthony was born in Coventry, R. I., Nov. 17, 1835, and was graduated from Yale. He taught physics in Iowa Agricultural College and in Cornell for 18 years, and then went into business for himself as a consulting engineer. In 1895 he became professor of physics and electrical engineering at Cooper Union, and three months ago was retired from the faculty and made professor emeritus. Prof. Anthony was a member of the American Institute of Electrical Engineers, the Franklin Institute of Philadelphia, and the American Social Science Association. He is survived by one son, Charles C. Anthony, assistant to the chief of the signal service of the Pennsylvania Railroad. He was president of the American Institute of Electrical Engineers in 1890-1 and always took a deep interest in the welfare of the organization. He was practically the first American professor of electrical engineering, his work in this direction at Cornell being altogether of a pioneer character, and having a marked influence on the trend of electrical study in this country. Prof. Anthony was a man of natural dignity and great modesty, too little self-assertive, and always interested rather in the work itself than in any credit or glory it might bring him. This year when it was proposed that he should accept the pension now available to a professor of his standing and record, he demurred very strongly, and was keenly wishful of staying in harness instead of going upon the retired list. He was the author of one or two useful technical books, and of several contributions to scientific and engineering societies.

PROF. W. A. ANTHONY.

Trade Publications.

THE SPRAGUE ELECTRIC COMPANY, New York City, is distributing a series of attractive blotters to advertise its well-known and popular electric fans. It has also issued catalogue No. 317 describing its long line of electric fans for every use, and a folder describing its new stamped-steel octagon box No. 6250. This box is a departure from former practices in the stamped steel line and undoubtedly will be welcomed by the electrical trade. Folder No. 431 tells the story concisely.

CONDULETS.—In its book of "'Condulet Suggestions," the Crouse-Hines Company, Syracuse, N. Y., shows innumerable locations where "Condulets" have been used with marked success.

WIRING CONDUITS.—The "Kalkos" wiring system, employing tinned tubes, is thoroughly illustrated and described in catalogue No. 160 of the Sun Electrical Co., Ltd., 118 Charing Cross Road, London, W. C.

ELECTRICAL SUPPLIES.—Railway material and electrical supplies are interestingly described in the May number of "Keystone Traveler," issued by the Electric Service Supplies Company, 1020 Filbert St., Philadelphia.

CONTROLLER FITTINGS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued bulletin No. 281, dealing with crane fittings and switchboards, knife-switches, circuit-breakers, grid-resistors, coil-resistors, etc.

VERTICAL STEAM ENGINES.—The American Blower Company, Detroit, Mich., has issued as sectional catalogue No. 232, a well-illustrated description and pricelist of high-speed, enclosed, self-oiling steam engines of the vertical type.

WATER-COOLING TOWERS.—Edwin Burhorn, 71 Wall Street, New York, has issued an illustrated catalogue dealing with "Burhorn" and "Acme" water-cooling towers. Much valuable information is given concerning the theory of cooling towers.

ELECTRIC HEAD-LAMP.—A complete electric lighting equipment for a steam locomotive, consisting of a self-contained steam turbo-generator and an arc lamp with reflector, is described in catalogue No. 145 of the Dayton Manufacturing Company, Dayton, Ohio.

CIGAR LIGHTER.—The F. Bissell Company, Toledo, Ohio, has issued a folder dealing with its three-in-one electric combination for use around automobiles and launches. The device consists of a cigar lighter, an electric repair lamp and an acetylene-lamp lighter.

"TRUMBULL CHEER" for June, isued by the Trumbull Electric Manufacturing Company, of Plainville, Conn., is full of bright sayings with regard to general conditions of the trade and as to its own light and power specialties in switchboard material, etc.

ELECTRICAL SUPPLIES.—The June calendar card of the F. Bissell Company, Toledo, Ohio, calls attention to the advantage to its customers of becoming friendly with the company, by writing occasionally for information concerning electrical supplies and machinery.

MAGNETO TELEPHONES.—Pamphlet No. 7 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., advocates the use of "sure-ring" condensers with magneto telephones and advertises what is claimed to be the highest grade condenser made for this purpose.

WIRING SUPPLIES.—General Catalogue No. 809 of the J. Lang Electric Company, 116 Lincoln St., Chicago, is devoted to electrical distributing apparatus, including switches, fuse-blocks, panel boards, wall and floor boxes, steel and wood cabinets, switchboard and switchboard instruments.

TELEPHONE SWITCHBOARDS.—Bulletin No. 105 of the Dean Electric Company, Elyria, Ohio, deals with common-battery switchboards in a logical and convincing manner by eliminating hackneyed phrases and including only such vital information as will enable a person to judge of the features of the apparatus.

AUTOMOBILE FACTORY EQUIPMENT.—The George N. Pierce Company, Buffalo, N. Y., has issued an elaborate description of its factory where the Great Arrow car is produced. The energy for operating the entire establishment is obtained from a central electric generating station containing direct-connected engine-driven units.

ELECTRICAL SPECIALTIES.—The detailed catalogue of the Crouse-Hinds Company, Syracuse, N. Y., is devoted to panel-boards, switch-boards, knife-switches, incandescent and arc head-lamps, arc lamps, harpoon guy-anchors, Norbitt porcelain specialties, and electrical and mechanical specialties. This is a loose-leaf catalogue with an excellent thumb index.

ELECTRIC FANS.—The 1908 catalogue of electric fans issued by the Sprague Electric Company is a neatly-executed publication printed in two colors. In addition to the well-known Lundell fans, the catalogue contains illustrations and descriptions of ceiling fans, fans for telephone booths and Midget exhaust fans. It also shows a line of alternating-current fans.

MACHINE TOOL REFINEMENT.—The National Acme Mfg. Company, of Cleveland, O., is sending out, to illustrate an accompanying leaflet, a specimen of work made on its automatic multiple-spindle screw machine. This consists of a screw, thread, spindle and a cone at the end of the latter brought to a needle point, all automatically cut at one operation, the material being machine steel.

COMMUTATING POLE RAILWAY MOTORS.—Bulletin No. 4582, of the General Electric Company, Schenectady, N. Y., describes the G. E. 203 railway motor. While this motor is similar in design and construction to other standard G. E. motors, it is provided with commutating poles located between the main field poles. The commutating pole railway motor is especially adapted for use with higher operating voltages on account of the inherent good commutating and non-flashing properties, which allow for a considerably increased overload capacity. This motor is, therefore, especially adapted for operation on heavy grades or with equipments geared for high-speed work, which have also to start and stop frequently, as in city services. An extensive description of the mechanical and electrical details of the apparatus is given in the bulletin. Under the heading of "rating" several pages are devoted to the proper selection of railway motors for various services, and a table is given showing schedule speeds under different conditions. Characteristic curves of different motors and dimension diagrams are included.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

TORONTO, ONT., CAN.—Smith, Kerry & Chace, consulting and constructing engineers, have submitted a proposition to the Board of Control offering to take charge of, and carry out the detailed designs, plans and specifications and forms of bids, etc., for the construction of the city's electrical plant at a rate of 1½ per cent of the estimated cost of the construction of the plant. In case the city should construct the plant the company offers to superintend the construction work including the cost of inspection of the machinery during the process of manufacture at the factories, and also inspection of the construction of the conduit system, at a rate of 4½ per cent of the cost, to include the 1½ per cent quoted on the designs and specifications.

BRANDON, MISS.—The Planter's Gin Compress Company contemplates purchasing electrical equipment to light its warehouse by electricity. William H. Turcott is secretary.

MODESTO, CAL.—The La Grange Water & Power Company has applied to the Board of Supervisors for a franchise to erect and maintain telephone wires, cables, poles, mains, conduits and other appliances for transmitting electricity, gas, water, and for other purposes along, over and under the streets and public highways of the county.

GEORGETOWN, CAL.—Notice of appropriation of 2000 cu. in. of water in the Cosumnes River has been filed by T. C. Purcell, to be used for milling, mining, irrigating and power purposes.

ORLAND, CAL.—Plans are being made by Charles A. King to install a pumping plant and electric motor to supply water for household purposes and for irrigating his property.

CLINTON, MASS.—The Clinton Gaslight Company contemplates extending its transmission lines to the State Industrial School for Girls in Lancaster for the purpose of furnishing electricity for lighting the buildings.

GREAT BARRINGTON, MASS.—The Stockbridge Electric Company is making arrangements to erect 70 or more new electric lamps, which will be placed in the Furnace District, Stockbridge Village and Interlaken.

ELREKA, CAL.—G. M. Scott has filed a claim of 500 cu. in. of water in Old Mill Creep to be used for water supply for Trinidad and vicinity, and also for generating electricity.

LEOMINSTER, MASS.—As the special lighting committee appointed to make arrangements with the Leominster Electric Light & Power Company has been unable to make satisfactory terms with the company, the State Commissioners of Gas and Electricity have been asked to determine the price that the city should pay for electricity for lighting the streets of the city. A substantial reduction in price is also asked for the general public.

SOMERVILLE, MASS.—The American Tube Works have recently increased its electric motor power equipment by the addition of three 25-hp motors, for which the Edison Electric Illuminating Company furnishes the electrical service.

RAINER, ORE.—The Rainer Electric Company has secured a franchise to erect poles and wires and to construct underground conduits for the distribution of electricity for lamps and motors in the city.

BUCKLAND, MASS.—The Selectman and citizens have petitioned the Greenfield Electric Light & Power Company, of Greenfield, to extend its transmission lines from the Gardner Falls plant to this town for the purpose of furnishing electricity to light the streets of the town and for lamps and motors to private interests. It is claimed that the service can be secured at quite a saving from the Greenfield company over the present rates charged by the local company, which is seeking incorporation with a view to furnishing electricity for motors as well as for lamps.

TWIN BRIDGES, MONT.—It is reported that the Madison River Power Company is to erect a power plant at Parrot near the site of the Parrot smelter.

REDDING, CAL.—David E. Aldridge has filed notice of appropriation of 300 in. of water flowing in the bed of North Bear Creek to generate electricity for lamps, motors and other purposes.

FARMINGTON, MAINE.—The Franklin Power Company has commenced work on the construction of its dam on the Carrabassett River between the towns of Embden and North Anson. The dam will have a head of 25 ft. and will furnish power to generate electricity which will be distributed in the towns of New Vineyard, Farmington and Wilton for lamps and motors. A transmission line 16 miles in length is now being erected to the town of Farmington. The Farmington Power Company, was formerly known as the Carratunk Power Company, chartered in 1903, and is capitalized at $100,000. S. E. Tarbox, of Farmington, is president and C. O. Sturtevant, of Winthrop, treasurer.

REDLANDS, CAL.—Articles of incorporation have been filed for the Redlands Construction company with a capital stock of $500,000 by J. M. Neeland, N. M. Newmark, A. P. Maginness, M. H. French, W. D. Larrabee, Paul Hirsch, C. S. Chesnut, W. M. Campbell and O. M. Miller, all of Los Angeles, and Redlands. The company will have charge of the construction of the Redlands and Yacaipa Railroad. The directors

of the railroad company have decided to increase the capital stock of the company from $1,000,000 to $2,000,000, for which a meeting of the stockholders has been called for July 23.

CLEVELAND, OHIO.—The Cuayhoga Light, Heat & Power Company has been incorporated with a capital stock of $10,000 by Milton C. Canfield, Mortimer A. Munn, G. B. Siddall, Louis Englander and John P. Dempsey.

UPPER SANDUSKY, OHIO.—Articles of incorporation have been filed for the Columbus, Marion, Upper Sandusky & Toledo Construction Company to construct an electric railway to connect the towns named in the title. The incorporators are: J. Kent Hamilton, George A. Bassett, George P. Kirby, W. L. Rowland and W. S. Thurston, Jr., all of Toledo.

TOMAH, WIS.—The Tomah Electric Light & Power Company has filed articles of incorporation with a capital stock of $30,000. The incorporators are: Lamont Rowlands, Miles A. Goodyear and Josephine G. Rowlands.

IN RECEIVER'S HANDS.—H. H. Carr, of the Raleigh Electric Company, has been appointed receiver of the Fayetteville Gas & Electric Company, of Fayetteville, N. C., by Judge Thomas B. Purnell, of the United States district court, on application of bondholders and stockholders of the company, the American Surety & Trust Company, of New York, N. Y., taking the initiative. The Company is bonded for $50,000.

THE ROCKWELL FURNACE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000, by William F. Baxter, L. D. Rockwell, both of New York, and Walter Ackerman, Sheepshead Bay, N. Y.

THE SYNCHRONOUS MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000. The directors of the company are: Wilson W. Hoag, Miriam E. Holbrook, of New York, N. Y., and Francis D. Tandy, of Piermont, N. Y. The company proposes to manufacture electrical machines.

THE VOLKMER ELECTRICAL COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000. The directors of the company are: Edward Volkmer, Hugo Hoffstaedter, and J. B. Morris, all of New York, N. Y.

NATCHEZ, MISS.—Bids will be received at the office of George T. Eisele, city clerk, until June 17 for lighting the streets of the city for a term of five years from March 1, 1909.

ILION, N. Y.—The Board of Electric Light Commissioners is contemplating purchasing electrical power to operate the municipal electric light plant.

NEWBURGH, N. Y.—The Newburgh Electric Light, Heat & Power Company has entered into a contract with the Honks Falls Electric Power Company for electrical energy, a portion of which will be generated at its plant at Honks Falls, about 30 miles from Kingston. The Honks Falls Elcctric Power Company proposes to erect an additional plant at High Falls, near its present plant, which will be completed next October. A transmission line will be erected from the power house to this city during the summer. The Newburgh company now supplies electricity for lamps and motors in Milton and Marlborough, and also furnishes electrical energy for operating the system of the Cornwall Electric Lighting Company.

NIAGARA FALLS, N. Y.—Plans are being considered by the merchants of this city for extra illumination of Falls Street from Second Street to the monument. The project contemplates a series of ten or more arches carrying about 450 incandescents lamps of 16 cp. Sufficient money has been raised to erect ten arches.

Business Notes.

THE INTERNATIONAL ELECTRIC METER COMPANY'S switchboard instruments are being used in the new substation at Emerald Avenue being built by the City of Chicago.

MR. R. C. CAMPBELL, Philadelphia, district manager for the Adams-Bagnall Company, of Cleveland, sailed for Europe on May 30 for a stay of two or three months to be devoted to investigation and research in the interest of the company.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, Ill., and 136 Liberty Street, New York City, is placing on the market a new design of a sectional switch box. It is so designed that a single box can be converted into any number of gangs by releasing the clamping screws and inserting "Spacers." These gangs "hook" together, there being no screws to take out and lose; they are easily assembled and fit together snugly, making a perfect and solid gang box. With the new style sectional box only two parts—single boxes and spacers—need be carried in stock, and a gang box of any required size can be quickly assembled.

5,000,000 CIRC. MIL CABLE.—What is believed to be the largest conductor ever manufactured has recently been shipped by the Standard Underground Cable Co. to the Transit Development Co., of Brooklyn. This cable has a cross-sectional area of 5,000,000 circ. mil, made up of 427 wires arranged in 61 strands of 7 wires each. The insulation consists of a single weather-proof braid. The following figures will give some idea of the great size of this cable: Diameter of bare strand, 2 57/64 in.; diameter over insulation, 3 1/16 in.; weight of bare strand, 16.2 lb. per foot; weight of completed cable, 16.6 lb. per foot. The cable was furnished in 440 ft. lengths, each length constituting 7300 lb. of cable.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, October, 1908.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Atlantic City, N. J., June 29-July 2.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512, Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary P. W. Drew, Room 511 Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting at Toronto, June 17, 18 and 19.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind. Next meeting, Sept. 24, 1908.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-second St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., Aug. 19, 20 and 21, 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ware, Grand Rapids, Mich.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

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OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

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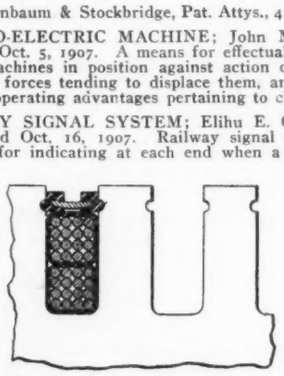
Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 26, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

888,456. DYNAMO-ELECTRIC MACHINE; John M. Barr, Pittsburg, Pa. App. filed Oct. 5, 1907. A means for effectually holding the coils of open slot machines in position against action of centrifugal, magnetic and other forces tending to displace them, and at the same time to provide the operating advantages pertaining to closed slot machines.

888,483. RAILWAY SIGNAL SYSTEM; Elihu E. Gabbart, Kingsland, Tex. App. filed Oct. 16, 1907. Railway signal system adapted for use on curves for indicating at each end when a train enters at the other end. Makes use of tappets closing circuits at the entrance to the section, and actuating signals at the other end.



888,456—Dynamo-electric Machine.

888,507. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed April 25, 1904. In telephony, means to neutralize earth currents in a line of transmission, said means comprising an inductorium, one coil connected to the line of transmission, the second coil connected to the ground; one of said coils constructed so that one part has an inducing effect opposite to the inducing effect of the second part.

888,509. CABLE TELEGRAPHIC SYSTEM; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 17, 1906. Makes use of an extremely sensitive relay in a cable system, which shall control a circuit or circuits associated with or including a second relay of less sensitiveness, the second relay serving to produce or record messages at its station as received by the extremely sensitive relay, and to repeat such messages received by the extremely sensitive relay into another line or cable.

888,510. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 9, 1906. Relates to modifications of the above.

888,511. DUPLEXING TELEGRAPH LINES; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 9, 1906. Is designed to dispense with the usual artificial cable at each station.

888,514. ARMATURE WINDING FOR ELECTRICAL MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed Aug. 17, 1904. A winding for polyphase electrical machines comprising a plurality of coils that are divided into a plurality of groups for each phase of the current, the sides of the coils of each group alternating in position with the sides of the coils of other groups.

888,517. RHEOSTAT; Seth A. Leonard, Cleveland, Ohio. App. filed June 17, 1907. Makes use of a main frame having a series of horizontal bars arranged in parallel relations at different elevations, and a series of resistance units mounted in parallel rows thereon and apart from one another, said units comprising flat plates and having helical resistance coils secured on opposite sides thereof.

888,557. SYSTEM OF ELECTRICAL CONTROL; Hermon L. Van Valkenburg, Pittsburg, Pa. App. filed Sept. 2, 1904. Provides means for effecting step by step or successive operation of the unit switches by successive operation of a manually controlled master switch. Designed for electric railway motors to simplify and lighten the apparatus.

888,602. SECONDARY BATTERY; Richard J. Feischer, Milwaukee, Wis. App. filed April 8, 1907. Comprises a partitioned bar having an upper outer flange below its rim, a cover having a continuous underside groove engaging the rim, and a groove engaging each partition.

888,610. APPARATUS FOR MANUFACTURING CARBID; Herman L. Hartenstein, Constantine, Mich. App. filed Nov. 30, 1906. Provides improved means in the manufacture of carbid, whereby the lime resulting from calcining the calcium carbonate will be discharged from the calcining furnace at substantially the hottest point thereof. Has means whereby the gas evolved in the electric furnace may be utilized for heating or burning the limestone carbonate.

888,611. SPARK COIL; John Otto Heinze, Jr., Lowell, Mass. App. filed March 6, 1908. Each coil has a metallic clip connected thereto which engages the adjacent coil, so that one cannot be removed from the box without the other.

888,613. ELECTRIC RAILWAY SIGNALING SYSTEM; Edward B. Howell, Butte, Mont. App. filed Aug. 22, 1907. Relates to a system of electric communication adapted for use in connection with railway

trains where it is desired to place the engine to each train in a position to be able to transmit and receive signals to and from other trains and a station.

888,648. ELECTRICAL APPLIANCE FOR CONTROLLING AIR BRAKES; James G. Pearce and William H. Pearce, Oakland, Cal. App. filed Nov. 16, 1906. Has an electrically actuated brake controlling valve of novel construction, auxiliary to the well-known engineer's valve on the locomotive engine. Includes a system of circuit-forming conductors and contact blocks on the roadway, in combination with the track rails and with a local battery or source of current on the train.

888,674. CONNECTING CONDUCTOR FOR CABLES; Francis S. Viele, of Pittsburg, Pa. App. filed Aug. 15, 1902. A form of lead sheathing for joining cable terminals, designed to have an insulation of uniform thickness and electrical strength.

888,677. TROLLEY; Charles Myron Whitcomb, Portland, Ore. App. filed April 9, 1906. A trolley wheel of generally spherical form, having a spiral groove on each side to guide the trolley wire onto the central or normal running groove.

888,692. SELECTING DEVICE FOR ELECTRICAL SIGNALING APPARATUS; John Burry, Ridgefield Park, N. J. App. filed July 18, 1906. A circuit controller for operating a number of remote devices, such as electric bells or printing magnets, selectively.

888,748. SIGNAL APPARATUS FOR TELEPHONE SWITCHBOARDS; George H. Ryder, Somerville, Mass. App. filed May 17, 1905. A signal apparatus for telephone switchboards, having, in combination with a line relay, a line signal in circuit with the contact of the relay, a supervisory signal, and means for short-circuiting the line signal and for placing the supervisory signal under control of the same relay contacts.

888,759. AUTOMATIC MOTOR STARTER; Edwin H. Smythe, Chicago, Ill. App. filed Aug. 17, 1905. A device for gradually and safely regulating the flow of current through a motor when it is being started in motion. Comprises an electromagnet electrically operated according to the varying potentials of the motor armature to successively cut out portions of a resistance included in the armature circuit.

888,760. CIRCUIT BREAKER; Edwin H. Smythe, Chicago, Ill. App. filed Aug. 17, 1905. A circuit breaker having circuit terminals each of which is preferably composed of a pair of laminated contacts and a bridging member in two parts linked together by a toggle arrangement, so that, when the switch is being closed, the parts of the bridging member are first brought between the opposing laminae and then spread outward with great pressure to make their contacts.

888,763. LINE WIRE FASTENER; Lafayette Stanton, of Beaver River, N. Y. App. filed Aug. 1, 1907. A form of line wire fastener having a rigid loop and a pair of flexible bands co-operating therewith, to surround the insulator.

888,801. APPARATUS FOR MEASURING LIGHT; William J. Hammer, New York, N. Y. App. filed Oct. 31, 1906. In a light measuring apparatus, the combination of a source of light to be measured, means for causing the source of light to vary an ascertainable physical quantity, and means for measuring the variation.

888,802. METHOD OF MEASURING LIGHT; William J. Hammer, New York, N. Y. App. filed Oct. 31, 1906. The new art of measuring light, which consists in causing the light to be measured to vary an ascertainable physical quantity, and measuring the extent of the variation.

888,822. TELEPHONE CUT-OFF OR MUFFLER; George S. Knowles, Buffalo, Mo. App. filed Oct. 30, 1907. A telephone cut-off or muffler comprising a plate having an opening therein for the clapper of a telephone, and means on the plate adapted to prevent the clapper from striking the bells.

888,843. ELECTRIC FLAT IRON AND CONDUCTOR; Paul E. Oswald, Los Angeles, Cal. App. filed March 14, 1907. Construction of flat or sad iron having a hollow interior with a sheet-iron resistance element formed of zig-zag stampings.

888,845. ELECTRIC SIGNALING; William E. Hallett and Frank Kamerer, New York, N. Y. App. filed May 29, 1907. A burglar alarm making use of a circuit-closing button in the window sash, which is forced inward to close the circuit by an upward movement of the pane.

888,870. TELEPHONE SYSTEM; Elmer R. Corwin, Clyde, Ill. App. filed May 11, 1906. Details of complete central exchange cord and signal circuits.

888,871. TELEPHONE SYSTEM; Elmer R. Corwin, Clyde, Ill. App. filed May 11, 1906. Relates to modification of the above.

888,872. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin, Chicago, Ill. App. filed Oct. 1, 1906. Additional modification of the above.

888,873. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin, Chicago, Ill. App. filed Oct. 1, 1906. Covers further modification.

888,874. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin; Chicago, Ill. App. filed Oct. 1, 1906. Additional modification of 888,870.

888,877. ELECTRIC FURNACE; Léon Dion, Wilkes-Barre, Pa. App. filed April 30, 1906. A furnace adapted for fusing metals in their crude and reduced states, having various detail features to permit the fusing of the metal without escape and loss of fumes and vapors arising therefrom.

888,901. ELECTRICAL APPARATUS; Ray P. Jackson, Wilkinsburg, Pa. App. filed Sept. 3, 1907. A conical insulating body is surrounded by a bell-shaped sheathing adapted to cause a proper distribution of the potential between the support and the conductor.

888,903. CONTROL SYSTEM FOR ELECTRIC MOTORS; Henry D. James, Pittsburg, Pa. App. filed March 3, 1906. A control system for electric motors having a plurality of switches adapted to be operated in a predetermined sequence for trains, etc. Has a limiting device to retard the sequential closure of the switches under sertain circumstances.

888,904. SYSTEM OF ELECTRIC MOTOR CONTROL; Henry D. James, Pittsburg, Pa. App. filed March 3, 1906. Relates to modifications of the above.

888,912. METHOD OF OPERATING AND SYSTEM OF CONTROL FOR ELECTRICAL GENERATORS; Benjamin G. Lamme, Pittsburg, Pa. App. filed Aug. 2, 1906. The method of operating a generator having series connected field magnet and armature windings, which consists in first connecting the secondary battery in shunt relation to the field magnet winding and in then connecting the generator in a braking circuit.

888,929. AUTOMATIC ELECTRIC RAILWAY SWITCHING DEVICE; Francis M. Rise, Dows, and Arthur W. Hill, Belmond, Ia. App. filed Sept. 19, 1907. The car has two reversely moving electromagnets extending down to close proximity to the rails, means for moving them transversely to the car and for connecting them for simultaneous movement in opposite directions to successively open and close a switch tongue.

888,940. DYNAMO ELECTRIC MACHINE; Egbert M. Tingley and Joseph L. Ray, Pittsburg, Pa. App. filed March 17, 1905. A connecting means between the rotatable winding of the dynamo electric machine and the collector rings which shall be entirely unexposed and capable of resisting high centrifugal forces.

888,951. STORAGE BATTERY PLATE; Theodore A. Willard, Cleveland, Ohio. App. filed March 26, 1907. The storage battery plate is roughened with longitudinal V-shaped serrations interrupted at spaced intervals by elongated holes through the plate.

888,956. PROCESS FOR THE MANUFACTURE OF OXYCARBID OF BARIUM; Rodolfo Battistoni, Ancona, and Romolo Rotelli, Venice, Italy. App. filed Jan. 14, 1905. Comprises mixing a predetermined amount of carbon with barium carbonate, melting the mixture in a furnace, and submitting the melted mixture to the electrolytic action of an electric current.

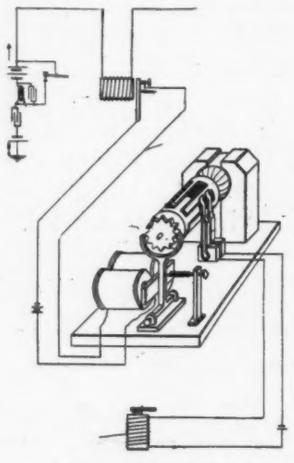
888,959. RAILWAY SIGNAL; Edgar M. Cain, of Wilmington, Del. App. filed Jan. 17, 1908. Detail features of a semaphore signal having an audible alarm whistle operated by an electromagnet, in addition to the usual semaphore.

888,980. RAIL BOND; Axel H. Englund, Philadelphia, Pa. App. filed June 16, 1904. The bond has a recess with a wall which extends entirely round the same, so that, when the bond is applied to a rail, the said recess is closed on all sides.

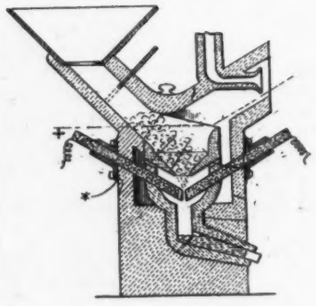
889,015. TROLLEY; Albert S. Janin, New York, N. Y. App. filed Nov. 16, 1906. A support for trolley rollers of the kind used by electric locomotives, making use of a toggle or link support depressible in a vertical direction.

889,031. WIRELESS TELEPHONE; Francis J. McCarty, San Francisco, Cal. App. filed Dec. 2, 1904. In a telephone, means introduced into the primary circuit, said means comprising a plurality of primary windings, a secondary coil which is energized thereby, a mouthpiece, a transmitting diaphragm with metallic contacts and a microphone transmitter actuated in unison, means whereby a spark is produced, and the aerial transmitting medium is affected to transmit articulate speech, and a mechanism capable of receiving transmitted speech.

889,040. ELECTRIC HEATER; Edwin F. Porter, Boston, Mass. App. filed Jan. 29, 1906. A vehicle having a seat with a heel-board and



888,510—Telegraphy.



888,877—Electric Furnace.

an electric heater, and means for admitting air to the back of said heater and venting heat from the front of said heater.

889,041. CAR HEATING AND VENTILATING APPARATUS; Edwin F. Porter, Boston, Mass. App. filed Aug. 19, 1907. Relates to modifications of the above.

889,067. MERCURY VAPOR APPARATUS; Percy H. Thomas, East Orange, N. J. App. filed Jan. 6, 1904. Has a closed holder of silica and lead wires for connection with an external circuit, and a screen substantially impervious to ultra-violet rays. Designed to generate ozone in limited quantities.

889,098. PROCESS OF WINNING ALUMINUM OR OTHER METALS FROM THEIR COMPOUNDS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed Feb. 25, 1907. Consists in liberating aluminum from its oxid by electrolysis while associated with magnesium, calcium and sodium fluorids.

889,103. HOLDER FOR ELECTROPLATING; William Y. Buck, Muncie, Ind. App. filed Sept. 25, 1907. Makes use of twisted wire having loops of a special form adapted to receive spoons and the like.

889,124. MANUFACTURE OF CARBID; Herman L. Hartenstein, Constantine, Mich. App. filed Feb. 13, 1907. A composition of matter for use in the manufacture of carbid, consisting of lime, bituminous coal, coke or charcoal, and anthracite coal.

889,126. AUTOMATIC SAFETY DEVICE FOR CRANES; Nathan S. Haseltine, Swissvale, Pa. App. filed Aug. 16, 1907. Automatically breaks the power circuit to stop the operation of the mechanism in case of accident. Has a circuit controller engaging the cable, which depends from the winding drum.

889,128. APPARATUS FOR TREATING ORES; Wilbur Alsen Hendryx, Denver, Col. App. filed Nov. 26, 1906. Makes use of a tank and means for continuously aerating the contents thereof by lifting portions and moving them in a thin sheet or film in contact with the atmosphere.

889,162. ARC LAMP; William S. Weedon, Schenectady, N. Y. App. filed May 20, 1904. A flaming arc lamp having a mechanical feed mechanism particularly adapted to metalized carbons and having means for maintaining a suitable draft through the lamp in use.

889,163. ARC LAMP; William S. Weedon, Schenectady, N. Y. App. filed May 20, 1904. Relates to modifications of the above.

12,795. ILLUMINATING DEVICE; Alfred William Beuttell, New York, N. Y. App. filed March 25, 1908. A form of support for double-ended incandescent lamps having telescoping contact members and a spring enclosed by and tending to separate said members.

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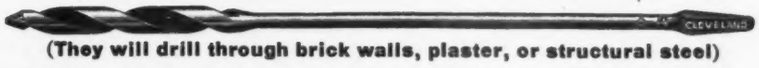

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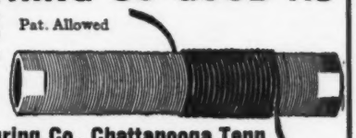

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